MAY 26 1932

VOLUME XIV NUMBER 2

JOURNAL of FARM ECONOMICS

APRIL, 1932

CONTENTS

The Shifting Demand for Selected Agricultural Commodities, 1875-1929. *Henry Schultz* 201
The Effect of a Business Depression on the Demand for Livestock Products and the Outlook for These Products. *Warren C. Waite* 228
Indications of Changes in the Demand for Agricultural Products. *E. J. Working* 239
Discussion. *Wassily Leontief* 256
International Relations and Financial Conditions in Foreign Countries Affecting the Demand for American Agricultural Products. *Leo Pasvolsky* 257
Discussion. *G. C. Haas* 265
European Competition in Agricultural Production. *Mordecai Ezekiel* 267
Discussion. *L. A. Wheeler* 281
The Wheat Problem in U.S.S.R. *V. P. Timoshenko* 284
The Concept of Marginal Land. *G. M. Peterson and J. K. Galbraith* 295
Effects on American Agriculture of a Duty on Philippine Coconut Oil and Copra. *Philip G. Wright* 311
Forecasting the Yield of Winter Wheat Seven Months Prior to Harvest. *Homer J. Henney* 319
Trends in Machinery Cost and Wages Paid to Farm Labor. *C. M. Purves* 331
Experiments in the Use of Large-Scale Machinery Under Montana Conditions. *E. A. Starch* 336
Research in Farm Equipment Costs. *W. A. Minor, Jr.* 341
Layout as Related to Efficiency in the Use of Labor. *J. E. McCord* 345
Study of Labor Saving Methods and Technique on Vegetable Farms in Massachusetts. *Rollin H. Barrett* 351
Notes:
A Method of Processing Costs Between Main Products and By-products. *J. M. Tinley* 353
Agricultural Cooperation Among the Germans of Czechoslovakia. *S. Borodaewsky* 354
The Indebtedness of Agriculture in Czechoslovakia. *S. Borodaewsky* 355
Difficulties in Bulgarian Farming. *N. V. Dolinsky* 355
An Application of "Movement Theory" to the Behavior of Prices to Corn Prices. *R. M. Green* 358
Books Received 362
Book Reviews 363
News Items 369

Published Quarterly by
THE AMERICAN FARM ECONOMIC ASSOCIATION
Publication Office: 450 Ahnaip Street, Menasha, Wis.

Executive Office: Asher Hobson, Secretary-Treasurer,
University of Wisconsin, Madison, Wis.

Editorial Office: H. R. Erdman, Editor,
University of California, Berkeley, Calif.

Price: $3 per year, this issue $1.25

Entered as second class matter at the post office at Menasha, Wis. Acceptance for mailing at a special rate of postage provided for in the Act of February 28, 1925, authorized November 27, 1931.

The American Farm Economics Association

President—J. D. Black, Harvard University.
Vice-Presidents—V. B. Hart, Cornell University; C. L. Stewart, University of Illinois.
Secretary-Treasurer—Asher Hobson, University of Wisconsin.

PAST PRESIDENTS

William J. Spillman	1910-12
George F. Warren	1913
Daniel H. Otis	1914
Andrew Boss	1915
Harcourt A. Morgan	1916
Henry W. Jeffers	1917
George A. Billings	1918
John R. Fain	1919
Henry C. Taylor	1920
Walter F. Handschin	1921
Benjamin H. Hibbard	1922
Thomas P. Cooper	1923
Edwin G. Nourse	1924
Milburn L. Wilson	1925
Thomas Nixon Carver	1926
J. I. Falconer	1927
L. C. Gray	1928
H. E. Erdman	1929
H. C. M. Case	1930
O. C. Stine	1931

LOCAL FARM ECONOMIC ASSOCIATIONS

District of Columbia Chapter, Washington, D.C.
Cornell University, Ithaca, New York.
University of Wisconsin, Madison, Wisconsin.
Western Farm Economics Association, Moscow, Idaho.
Agricultural Economics Section, Asso. of Southern Agr. Workers, Raleigh, North Carolina.

THE JOURNAL OF FARM ECONOMICS, EDITORIAL STAFF

Editor—H. E. Erdman, University of California.
Associate Editors—O. B. Jesness, University of Minnesota.
H. B. Price, University of Kentucky.
L. P. Gabbard, Texas A. and M. College.
S. W. Mendum, Bureau of Agricultural Economics.
F. A. Pearson, Cornell University.

Inquiries regarding membership and general affairs of the Association should be addressed to the Secretary-Treasurer. Manuscripts or inquiries concerning the Journal should be addressed to the Editor or any one of the Associate Editors.

JOURNAL
of
FARM ECONOMICS

Vol. XIV APRIL, 1932 No. 2

THE SHIFTING DEMAND FOR SELECTED AGRICULTURAL COMMODITIES, 1875-1929[1]

HENRY SCHULTZ
UNIVERSITY OF CHICAGO

I. The Problem

In any discussion of an economic policy for agriculture, as well as in many other problems, two questions which constantly and significantly present themselves are: first, what is the shape of the demand curve for each of the more important farm goods, and, second, how do these curves shift their positions through time? It is only when we have answers to both of these questions that we can begin to estimate the probable future demand for these goods.

The common procedure for determining the future demand for a commodity is to fit a curve to the statistics of consumption for a period of years, and to estimate from the characteristics of this curve its probable future path. While this procedure is basic in any study of demand, it nevertheless is apt to lead to erroneous conclusions. The history of the consumption of any commodity is the resultant of two main cause groups: (1) changes in the price of the commodity from year to year (or from season to season), and (2) changes in factors that are more or less independent of these price movements. Examples of the latter are changes in the size of the population, changes in the purchasing power of money, and changes in tastes and desires. It is the combined effect of the two groups of factors that gives rise to an upward,

[1] Read before joint meeting of the American Statistical Association and the American Farm Economic Association, Washington, D.C., December 30, 1931.

This study was made possible through the generosity of the Social Science Research Committee of the University of Chicago. Miss Frances Gibson, Miss Edith Mohn, and Miss Janet Murray collaborated during the various stages of this investigation, and did most of the statistical work. Mr. Francis McIntyre and Mr. Sidney Sufrin gave me part-time assistance. The charts are the work of Mr. Lester Kellogg and Mr. Y. K. Wong. To all of them I owe a debt of gratitude.

horizontal, or downward trend of consumption. It may very well happen, however, that when allowance is made for one of these factors, the corrected trend of consumption may be accelerated, retarded, or even reversed. As an example of the latter, we may consider the downward trend of the per capita demand (consumption) for corn from 1896-1914. Analysis shows that it is due primarily to the upward movement in the real price of corn during the same period. When this price is fixed, the trend of the per capita consumption is seen to move upward.

Of the factors falling in the second group, some can perhaps be measured directly and some cannot be so measured. The latter are generally clubbed together and represented by the variable *time*.[2]

Let the relation between consumption (x), price (y), other measurable factors (z), (w), . . ., and time (t), be symbolized as follows:

$$x = f(y, z, w, \ldots, t). \tag{1}$$

Then if we fix all the independent variables except y, we obtain the law of demand for the commodity. If we fix all the independent variables except t, we obtain an expression for the rate at which the demand curve shifts its position per unit of time.[3]

TABLE 1. AGRICULTURAL COMMODITIES WHOSE SHIFTING DEMAND WAS ANALYZED FOR 1875–1929, WITH THEIR FARM VALUES IN 1915 AND IN 1925[a]

Commodity	Farm Value (In millions of dollars)	
	1915	1925
Total	5,009	6,142
Corn	1,723	1,967
Hay	914	1,195
Wheat	942	958
Sugar[b]	473	677
Potatoes	222	604
Oats	560	566
Barley	118	127
Rye	45	36
Buckwheat	12	12

[a] Source: Agriculture Yearbooks for 1920 and 1926.
[b] Represents United States consumption multiplied by the wholesale price of refined sugar at New York. Source: "Concerning Sugar," loose leaf service of the U. S. Sugar Manufacturers Association.

II. The Data

To determine how the demand curves for the representative crops are likely to shift in the near future, as well as to answer

[2] Pure time can hardly be thought of as a causal factor in economics. It must be considered as a catch-all for certain factors.

[3] For a comparison of the demand curve thus obtained with that of Cournot and Marshall, see my *Der Sinn der statistischen Nachfragekurven*, Veröffentlichungen der Frankfurter Gesellschaft für Konjunkturforschung (edited by Dr. Eugen Altschul), Bonn, 1930, pp. 12-39.

other questions which do not directly concern us here, I have made a study of the factors affecting the demand for nine farm commodities from 1875 to 1929, thus obtaining both the shape of the demand curve for each commodity and its rate of shift. Table 1 is a list of these commodities with their farm values in 1915 and 1925.

The demand curve that has the greatest significance for present purposes is that of wholesalers, dealers, and farmers. For the purpose of deriving such a demand curve the data that are required are "total disappearance" (production minus net exports, plus beginning stocks, and minus end stocks), and the average price at which all exchanges have taken place. Since, however, such complete data are not available, it is necessary to approximate the quantity of the commodity demanded from such series as may be obtained. For five commodities—buckwheat, corn, hay, oats, and potatoes—the United States Department of Agriculture estimates for production have been used.[4] The net exports or imports of these crops are small, seldom exceeding five per cent of production. There are no data on stocks; but there is reason to believe that the fluctuations in the carryover of each of these commodities from year to year are relatively small and do not have an important effect on the average price. Where net exports are of appreciable amounts, such as those for barley and rye, they have been subtracted from production estimates to obtain a "consumption" series. Unless otherwise specified the year of consumption is that beginning July 1.

The consumption data for sugar are taken from Palmer's "Concerning Sugar," a loose-leaf service of the United States Sugar Manufacturers' Association. They represent production plus imports *for the year beginning January 1.*

For wheat, a total disappearance series for food, feed and loss since 1896 has been derived from the estimates of stocks and seed requirements as given in the U.S.D.A. tables of wheat supply and distribution. These estimates are not available for the period preceding 1890. These total disappearance figures, though they are admittedly incomplete, nevertheless appear to give a closer indication of the quantity of wheat demanded in any one year than does the simpler series of production minus net exports.

The basic production estimates are not entirely reliable. A comparison of the Department estimates with Bureau of the

[4] Source: United States Department of Agriculture Yearbooks for 1927 and 1931.

Census figures shows wide discrepancies in some years. Thus for buckwheat, the Department estimate is 21 per cent higher than the census figure in 1909, and 11 per cent higher in 1924; for potatoes the estimates are 11 per cent higher than the census data in 1919, and 19 per cent higher in 1924; while for rye similar percentage differences are 20 and 18 for the census years 1909 and 1924.

Most of these discrepancies, however, throw more doubt on the actual *level* of the series used than on the year-to-year changes. If, through an error in determining the level of production in any one year, the true trend of production has been distorted, this will affect the rate of shifting of the demand curve derived from the data, but not necessarily its shape or its elasticity. The latter depends primarily on the year-to-year fluctuations of the quantities and the related prices.

In some instances, however, a special study of the data also led to serious doubts as to their relative accuracy in certain years. These observations were, therefore, omitted from the computations. Thus the years 1875-78 were omitted for corn and buckwheat; and 1893-98 for hay and oats when animal units were used. Also, abnormal adjustments of crops to demand for oats in post war years account for the extension of the war period omissions to 1923 for this commodity.

For all commodities except sugar and barley, the price series that was used is the December 1 farm price. This series was adopted primarily because it is available for the entire period covered by this study, and because it is an average of all classes and grades and therefore approximates our ideal figure—the average price at which the commodity changed hands in the country as a whole. The correlations between the December first price and the crop year average of monthly farm prices since 1909, the first year for which the latter are available, are very high, indicating that the December first price is typical of the price for the year as a whole.[5]

The price series for sugar relates to the year beginning January 1. It is the average New York wholesale price of refined sugar, as given in "Concerning Sugar," to which reference has already been made. This price was taken because New York was the dominant sugar market during the period covered by this investigation; prices in all markets throughout the United States were fixed by the New York price.

[5] Charles F. Sarle, "Reliability and Adequacy of Farm-Price Data," Bulletin No. 1480, U.S.D.A., March, 1927.

For barley, it was found that the Chicago price (an August-July average of quotations for choice to fancy or fair to good malting grades in Chicago) and the farm price, instead of showing the customary general agreement, differed definitely as to direction of trend during the first period, 1875-95. This seemed to be due to a decided shift in regions of barley production. The average farm prices for the earlier years of the period were heavily weighted by the high prices of such areas as New York and California; those for the later years by the low prices of the Chicago region. The Chicago price seemed, therefore, to be more representative of the general trend of barley prices throughout the country than the farm price.

All price series were deflated by the Bureau of Labor Statistics all-commodity index[6] of wholesale prices (1913 = 100). In 1928, the Bureau of Labor Statistics made several modifications in its index numbers of wholesale prices and changed the base to 1926 = 100. The new index numbers for 1928 and 1929 were, therefore, spliced on to the old series as follows: The new index (1926 = 100) was first shifted to 1913 as a base by dividing by the 1913 average. Then the figures for 1928 and 1929 thus obtained were multiplied by the ratio for 1927 of the old index to the new index with 1913 as a base.

December 1 farm prices have been deflated by the index number for December. December 1 farm prices as given in the Department of Agriculture Yearbooks are on a gold base, while Snyder's index is on a currency base. Because of the difference between currency and gold prices from 1875-78, it was necessary to reduce the index for those years to a gold base before using it as a deflator. The method followed was to divide the December index on a currency base by the average price of gold in greenbacks for December.[7] The Chicago price for barley has been deflated by the average index for the year beginning August. The New York wholesale price (yearly average) for sugar has been deflated by the average index for the year beginning January 1.[8] Since the Chicago price for barley and the New York wholesale price for sugar are both on a currency base throughout the period, it was not necessary to reduce the index to a gold base before deflating these prices.

[6] Data obtained from Carl Snyder, *Business Cycles and Measurements*, The Macmillan Company, New York, 1927, p. 288, and for later years from Bureau of Labor Statistics Bulletins.

[7] Mitchell, W. C., *Gold, Prices and Wages*, University Press, Berkeley, California, 1908, pp. 4-13.

[8] There has been a slight inconsistency in the method of splicing the index used to deflate sugar prices. The figures for 1927-1929 (1913 = 100) were multiplied by the ratio for 1926, instead of for 1927, of the old index to the new index with 1913 as a base.

The data are expressed in terms of bushels per capita and cents per bushel for all the commodities except sugar (pounds per capita and cents per pound), hay (tons per animal unit and dollars per ton), and oats (bushels per animal unit).

III. The Method

But the period from 1875 to 1929, which is covered by this study, saw too many changes in our economic history to constitute a homogeneous period for our purposes. I have, therefore, broken it up into three parts as follows: (1) 1875-1895, the period of general falling prices; (2) 1896-1914, the period of general rising prices; and (3) 1915-1929 (omitting 1917-1921), the period of the World War and reconstruction, and made a study of the data for each part, with the view of obtaining a better insight into the changes that have taken place in the shape of the demand curves and in the direction and rate of their shifting.

To answer certain other questions which do not directly concern us here, I have experimented with different methods—trend ratios, link relatives, multiple correlations, etc., and combinations of them—and have worked with total consumption and money prices as well as with per capita consumption and "real" prices. In order to throw light on still other problems, I have taken first consumption and then price as the dependent variable, and have also used other types of regression equations. Here I shall concern myself only with the regression of per capita consumption (x) on real prices (y) and time (t), and I shall consider for the most part regression formulas of the following types:

$$x = Ay^{\alpha}e^{\beta t} \tag{2.1}$$

$$x = Ay^{\alpha}e^{\beta t+\gamma t^2} \tag{2.2}$$

In these formulas, the exponent α is the partial elasticity of demand, η, for

$$\eta = \frac{\partial x}{\partial y}\cdot\frac{y}{x} = \frac{\partial \log_e x}{\partial \log_e y} = \alpha. \tag{3}$$

It gives, therefore, a convenient summary description of the shape of the demand curve.

The exponent β (or the expression $\beta + 2\gamma t$) gives the relative rate at which the demand curve shifts its position upward or downward, for, from (2.1),

$$\frac{1}{x}\frac{\partial x}{\partial t} = \frac{\partial \log_e x}{\partial t} = \beta, \tag{4.1}$$

and from (2.2)

$$\frac{1}{x}\frac{\partial x}{\partial t} = \frac{\partial \log_e x}{\partial t} = \beta + 2\gamma t. \tag{4.2}$$

In (2.1) the relative rate of shift is constant; in (2.2) it is a linear function of time. When these expressions are multiplied by 100, and time is measured in years, they give the rate of shift of the per capita demand as a per cent per annum.

Formulas (2.1) and (2.2) will be found to give an excellent description of most of the demand relations discussed in this paper. The complete set of formulas used will be shown later.

By fitting (2.1) and (2.2) to the data, we are, of course, assuming that the demand curve has a constant elasticity at every point. We may also fit curves of the type

$$x = a + by + ct \tag{5.1}$$

or

$$x = a + by + ct + dt^2, \tag{5.2}$$

and thus assume that the demand curve is a straight line whose elasticity varies from point to point. But I have shown elsewhere[9] that *within the limits of observation,* there is generally no signifi-

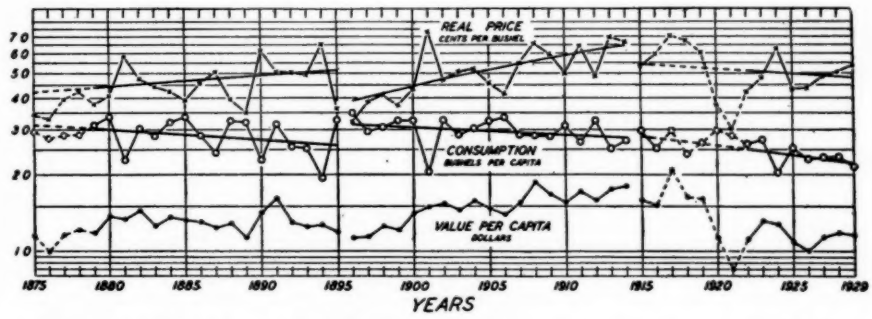


FIGURE 1.—The basic adjusted annual data used in deriving the elasticity of demand and the rate of shift of the demand curve for corn in the United States, by periods, 1875-1929, with the computed trends of the real prices and the per capita consumption.

(The dotted observations in the first and third periods are those which were not used in the computations.)

[9] "A Comparison of the Elasticities of Demand for Selected Commodities, Obtained by Different Methods," read before the Joint Meeting of the American Statistical Association with the Econometric Society, December 29, 1931 to be published in an early issue of *Oekonometrika*, the journal of the Econometric Society.

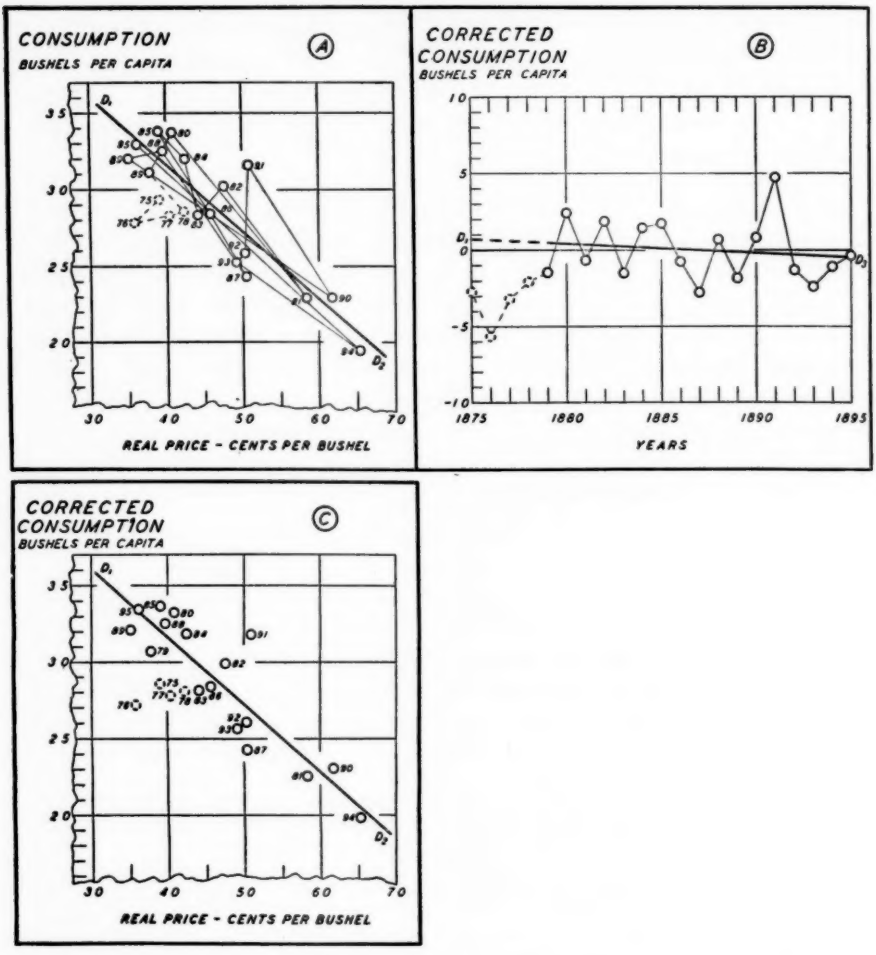


FIGURE 2.—Three aspects of the shifting per capita demand for corn during the period from 1879-95.

A.—Relation between the per capita consumption and the real prices when the data are not corrected for the effects of "time," with the demand curve D_1D_2 which results when such correction is made.

B.—Relation between the per capita consumption and time, when the former is corrected for the effects of changes in the real price.

The slope of line D_1D_3, fitted to the corrected data, represents the mean rate of shift of the per capita demand curve D_1D_2.

C.—The per capita demand curve for corn, 1879-95. Line D_1D_2 shows the relation between that part of the per capita consumption of corn in the United States which is independent of time, and that part of the real price which is independent of time.

In the scatter, however, the ordinates, but not the abscissas, have been corrected for secular changes.

cant difference in the results obtained by the two sets of curves.

It will be convenient, however, to begin with a consideration of the demand functions (5.1) and (5.2).

Figure 1 shows the real price, the per capita consumption, and the per capita real value of corn for each of the three periods. The term "per capita" is not to be understood as implying that people eat much corn. The series in question simply reflects the demand for corn reduced to a per capita basis. In a later study, I shall also consider the effect of the number of animal units on the demand for corn.

Although the value series will not be used in the present analysis, it is of importance in giving a rough and ready answer to the question whether the demand is elastic or inelastic. In the former case, a large crop is worth more than a small crop. But a large crop means a smaller price per unit, on account of the negative slope of the demand curve. Consequently, when the demand is *elastic,* the year-to-year changes in total value will tend to be *negatively* correlated with the corresponding changes in price.[10] On the other hand, when the demand is *inelastic,* the changes in total value will be *positively* correlated with the corresponding changes in price. By comparing the value series with the price series (or with the quantity series) we can observe when the correlation changes sign. That year is generally one in which a disturbing factor has made its appearance.[11]

Confining our attention for the time being to the data for the first period,[12] we observe that the series of prices and quantities exhibit a rather high inverse correlation. The existence of this correlation is also brought out very clearly in the scatter diagram (Figure 2A), in which the per capita consumption is plotted against adjusted prices. In this diagram, line D_1D_2 is the *net* regression of consumption on price. It gives the relation between that part of the per capita consumption which is linearly independent of time, and that part of the real price which is linearly independent of time. It is a good approximation to the demand curve for corn.[13]

---

[10] It is necessary to consider year-to-year changes in order to allow at least approximately for long-time secular movements.

[11] Professor C. Bresciani-Turroni has used this method to good advantage. See his "Über die Elastizität des Verbrauchs ägyptischer Baumwolle," *Weltwirtschaftliches Archiv,* Band 33, Heft 1, January, 1931, pp. 46-86, or his "Relations entre la récolte et le prix du coton Égyptien," *L'Égypte Contemporaine,* Tome XXI, pp. 633-689.

[12] The dotted circles show observations which were not used in the computations.

[13] The question may arise whether in view of the inverse secular movements of the per capita consumption and the real price (Figure 1), we should not take the *total* regression rather than the *net* regression as our demand curve. It may be asked, is not the increase in the real price of corn the *cause* of the decline in the per capita consumption? For a discussion of this question, see my *Statistical Laws of Demand and Supply,* University of Chicago Press, 1928, p. 78, and my *Der Sinn der statistischen Nachfragekurven,* p. 61.

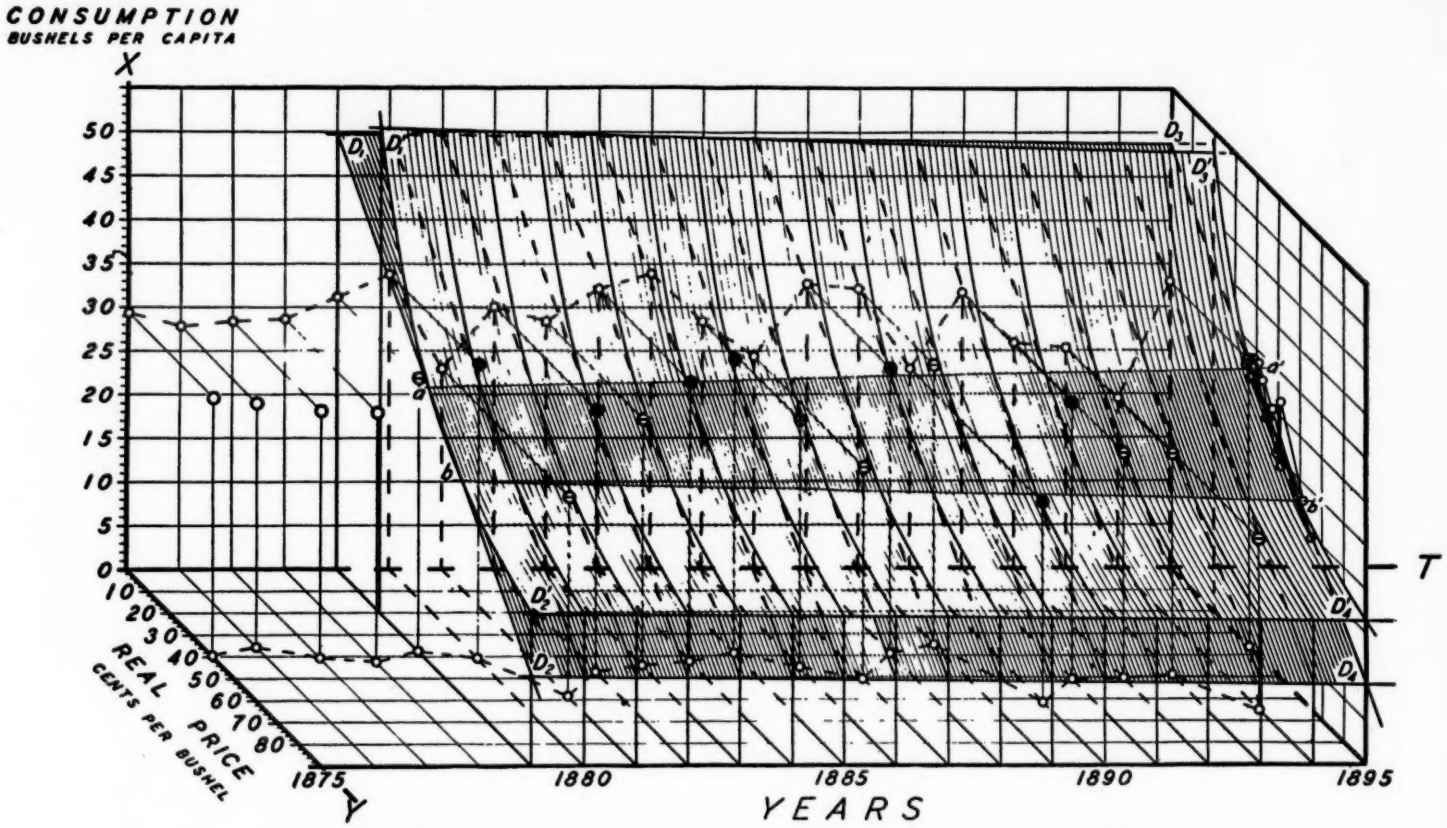


FIGURE 3.—The shifting per capita demand for corn, on two assumptions, 1879-95.
(For an explanation of the diagram, see the text.)

To determine whether and how far we can reduce the scatter about the demand curve D_1D_2 by assuming that it has shifted its position from year to year, we take the differences between the computed and the observed consumption (i.e., the vertical deviations), and plot them as a function of time. The results are shown in Figure 2B. To these deviations there has been fitted the straight line D_1D_3. The slope of this line is slightly downward. It shows that the demand curve has, on the average, shifted downward during the period in question. But this slope is not significant, as it is exceeded by its standard error.

When allowance is made for this slight downward shift, we obtain the reduced scatter of Figure 2C.

In this particular example, the use of the additional variable time has brought about no significant improvement in the results. We shall see, however, that this is not true of the second period.

The three diagrams shown in Figure 2 are, however, only different aspects of the three-dimensional relation shown in Figure 3. In Figure 3, each observation is shown in three dimensions. (The significance of the black and the white circles will be explained later.) For example, the first observation shows that in 1875, the price was 39 cents a bushel, and the consumption was 29 bushels.

The orthogonal projections of the observations (circles) on the vertical plane XOT give the fluctuations in the per capita consumption of corn which were shown in Figure 1. The corresponding projections on the horizontal plane YOT give the fluctuations in the real price of corn, which were also shown in Figure 1. The corresponding projections on the last (1895) plane give the scatter diagram of consumption on price, which was shown in Figure 2A.

The straight plane $D_1D_2D_3D_4$ (which will be designated henceforth as D_1D_4, is the demand surface which was fitted to the same data (the curved place $D_1'D_4'$ will be explained later). This surface is a graphic representation of the equation

$$(6) \qquad x = 49.25 - (0.4398 \pm 0.0614)y - (0.0611 \pm 0.1074)t,$$

the origin of x and y being at 0,0 and the origin of t being at 1887.[14] The observations which lie above both planes are represented by black circles. Those which lie below both planes are represented by single-barred circles ($\ominus$). Those falling between the two planes are represented by double-barred circles ($\oplus$).

[14] The figures preceded by $\pm$ are *standard* errors, not probable errors.

This equation means that on the basis of the experience of 1879-1895, an increase of one cent in the real price of corn, other things being equal, is associated with a decrease of 0.44 bushels in the per capita consumption, for

$$\frac{\partial x}{\partial y} = -0.4398. \tag{6.1}$$

This relation is indicated by the slope of the demand curve D_1D_2. It is this demand curve which is shown in Figures 2A and 2C.

But other things do not remain equal. The per capita consumption has decreased at the rate of 0.06 bushels per annum, for

$$\frac{\partial x}{\partial t} = -0.0611 \pm 0.1074. \tag{6.2}$$

This rate of shift of the demand is shown either by the slope of the line D_1D_3 or by that of D_2D_4. (Figure 3)

We are now in a better position to understand the geometrical significance of Figures 2B and 2C. Suppose that in Figure 3, the curved plane did not exist. Then suppose that the entire diagram, including the planes of reference, had been tilted backward about the axis OT until the edge D_2D_4 coincided with the edge D_1D_3. Figure 2B shows how the points and the plane would then appear.

Suppose next that—the curved plane still assumed to be out of the picture—we had taken a side view of the entire diagram. More definitely, suppose that we had tilted the diagram slightly forward about the axis OY until line D_1D_2 coincided with line D_3D_4. Figure 2C gives this aspect.

The fit of the plane D_1D_4 to the observations is very good. The quadratic mean error is only ± 2.09 bushels, which means that approximately two-thirds of the observations (points) fall within a distance of 2.09 bushels above and below the plane. The coefficient of correlation between the observed and the computed consumption is 0.90.

The partial elasticity of demand deduced from equation (6) is

$$\eta_{xy.t} = \frac{\partial x}{\partial y}\frac{y}{x} = -0.4398\frac{y}{x}. \tag{6.3}$$

It is clear that it varies from point to point on the demand curve. Though the variable t (time) does not enter into this equation, it must be used nevertheless (together with y) to compute the value of x from (6). It would be wrong to use the observed in-

stead of the computed value of the dependent variable, for the reason that the coefficient of the elasticity of demand *must relate to a point on the demand curve,* and the observed values of x do not generally lie on the curve.

The following example will illustrate the procedure for computing the elasticity of demand by (6.3). In 1883 the real price was 44 cents. Substituting this value for y in (6) and putting $t = -4$ in the same equation (since the origin of t is at 1887), we obtain for the theoretical per capita consumption 30 bushels. Substituting these values of x and y in (6.3), we obtain

$$\eta_{xy.t} = -0.65. \tag{6.4}$$

This means that if the real price which prevailed in 1883 had been decreased (or increased) by 1 per cent, and *if the demand curve had remained fixed for one year,* there would have been an increase (or a decrease) of 0.65 of one per cent in the annual per capita consumption.[15]

But the demand curve has not remained fixed. As is evident from (6.2), it has shifted its position downward and to the right at the rate of 0.06 bushels per capita per annum. But this decrease is not statistically significant, because it is exceeded by its standard error. We cannot assert, therefore, without additional evidence, that the demand curve for corn has, on the average, shifted either downward or upward during this period.

But when the rate of shift of the demand curve is expressed as so many bushels, pounds, etc., per annum, it is difficult to compare the rates of shift of demand curves for different commodities. For this purpose it is desirable to express the rate of shift of the demand curve for any commodity in relative terms, which are independent of the units in which the commodity is measured.

Two simple, convenient families of demand functions in which the rate of shift is so expressed are given by equations (2.1) and (2.2). (See equations 4.1 and 4.2).

The curved surface $D_1'D_4'$ is a graphic representation of such a demand function. Its equation is

$$x = 550.1y^{-(0.7749\pm 0.1100)}e^{(0.0032\pm 0.0040)t}, \tag{7}$$

where x, y, and t, have, respectively, the same meaning and the same origin as in equation (6).[16]

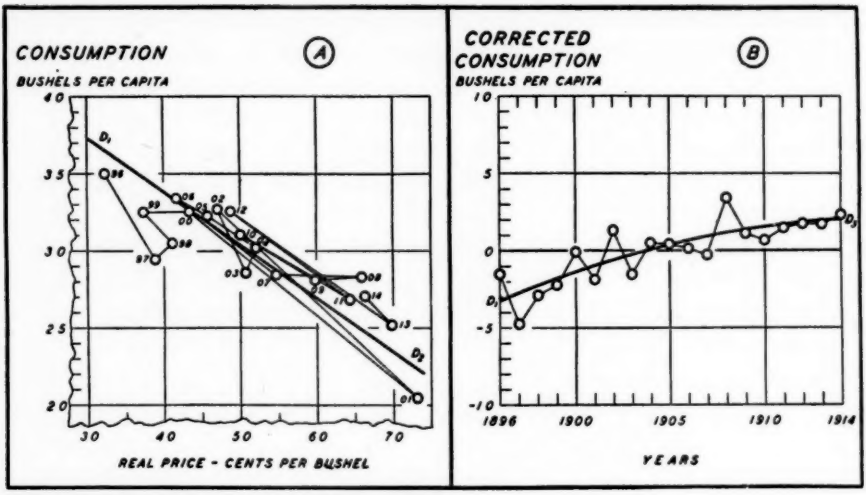
---

[15] The elasticity of demand is a function of the *time interval* between the successive observations on which the demand function is based. Thus, the use of monthly data might lead to a demand curve which is quite different from that based on annual figures for the same series.

[16] This curve (7) was fitted by first writing it in the logarithmic form

$$\log x = \log a + b \log y + Mct,$$

(where $M = \log_{10} e$) and by minimizing the sum of the squares of the logarithmic residuals. The fit obtained is not, therefore, comparable with that of (6), which was fitted by minimizing



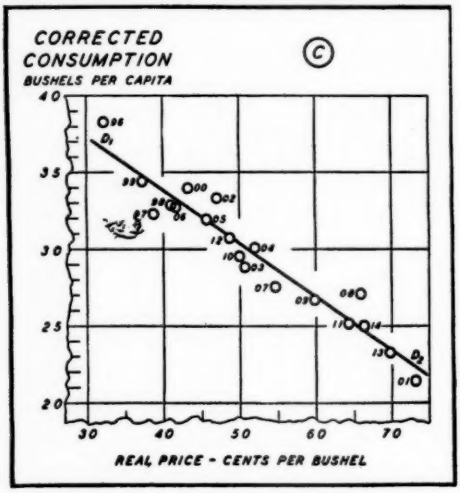


FIGURE 4.—Three aspects of the shifting per capita demand for corn during the period from 1896-1914.

A.—Relation between the per capita consumption and the real prices when the data are not corrected for the effects of "time," with the demand curve D_1D_2 which results when such correction is made.

B.—Relation between the per capita consumption and time, when the former is corrected for the effects of changes in the real price.

The slope of line D_1D_2, fitted to the corrected data, represents the mean rate of shift of the per capita demand curve D_1D_2.

C.—The per capita demand curve for corn, 1896-1914. Line D_1D_2 shows the relation between that part of the per capita consumption of corn in the United States which is independent of time, and that part of the real price which is independent of time.

In the scatter, however, the ordinates, but not the abscissas, have been corrected for secular changes.

This equation tells us that when the real price of corn is held constant, the per capita consumption decreases at the momentary rate of 0.32 per cent per annum, for

$$(7.1) \qquad \frac{1}{x}\frac{\partial x}{\partial t} = \frac{\partial \log_e x}{\partial t} = -0.0032 \pm 0.0040.$$

This is shown graphically by the slope of the curve $D_1'D_3'$, or by that of the curve $D_2'D_4'$. But this rate of decrease is not statistically significant, because it is exceeded by its standard error. We cannot assert, therefore, that the demand curve has on the average shifted either downward or upward during the period from 1879-1895.

The elasticity of demand is

$$(7.2) \qquad \eta_{xy.t} = \frac{\partial x}{\partial y}\frac{y}{x} = -0.7749 \pm 0.1100.$$

This means that if the real price which prevailed in any given year had been decreased (or increased) by 1 per cent, *and if the demand curve had remained fixed for one year,* there would have been an increase (or decrease) of approximately 0.77 of 1 per cent in the annual per capita consumption. It is not very likely to be numerically less than 0.6 nor greater than 0.9. The value of this coefficient is constant for every point on the demand curve.[17]

A glance at Figure 3 shows that the curved surface $D_1'D_4'$ intersects the straight surface D_1D_4 twice: along the curved line aa′ as it dips below the straight plane, and along the curved line bb′ as it emerges from under it. Unlike the straight surface D_1D_4, the curved surface $D_1'D_4'$ does not cut the vertical plane of reference XOT, but is asymptotic to it. However, in order better to show its relation to the straight surface, it was terminated at $D_1'D_3'$, which gives the consumption (x) for each year on the assumption that the price is kept constant at y = 20 cents.

Figure 3 also shows that within the range of variation of the data, there is no appreciable difference between the constant elasticity demand curve $D_1'D_2'$ and the straight line demand curve D_1D_2.

---

the sum of the squares of the actual residuals of x. It is possible so to weight the observation equations in (7) as to obtain a fit which comes pretty close to minimizing the sum of the squares of the residuals of x. But the slight difference in the results would hardly justify the extra time and effort that would be required by this method.

[17] In this curve, as well as in all the other curves listed in Table 2, the coefficient of elasticity of demand is independent of the rate of shift of the demand curve. Nevertheless, the italicized condition is necessary in order to emphasize the fact that it takes time for consumption to adjust itself to a price change. When the demand curve is derived from annual data, the necessary time interval is generally one year, or one season.

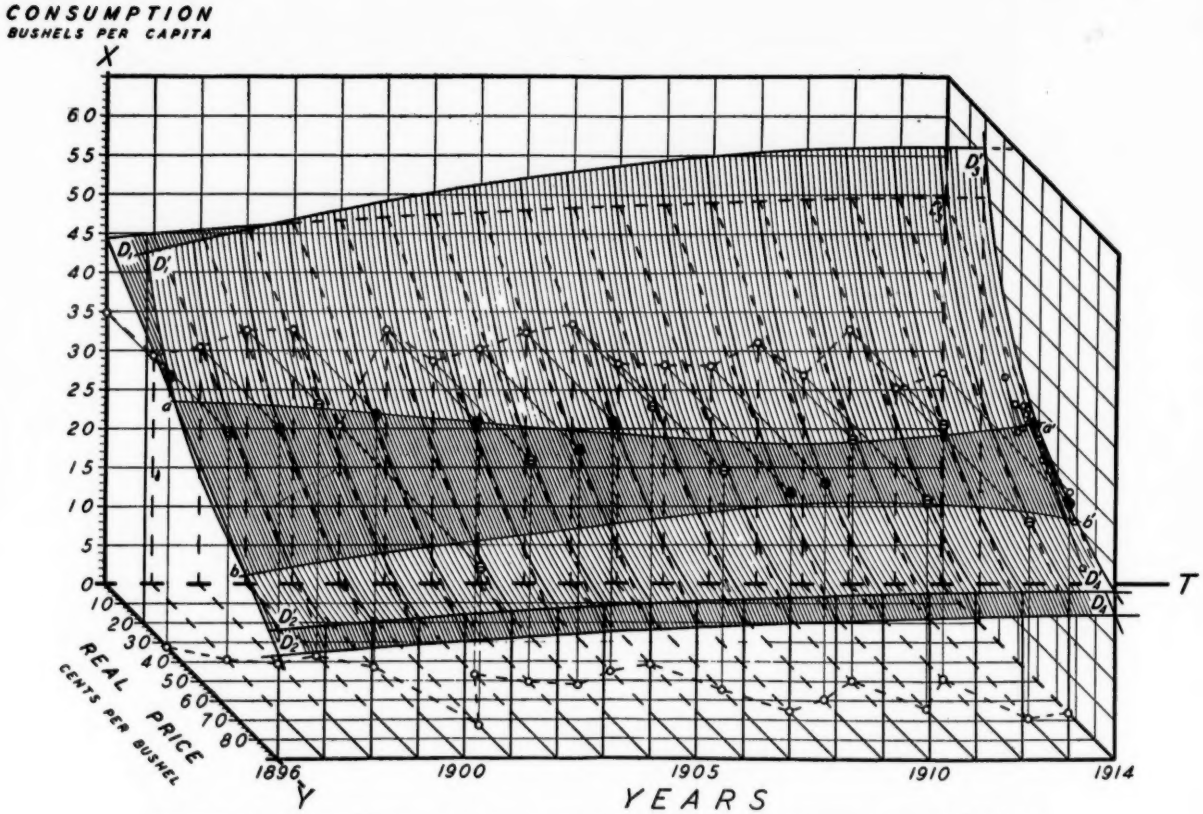


FIGURE 5.—The shifting per capita demand for corn, on two assumptions, 1896-1914.
(For an explanation of the diagram, see the text.)

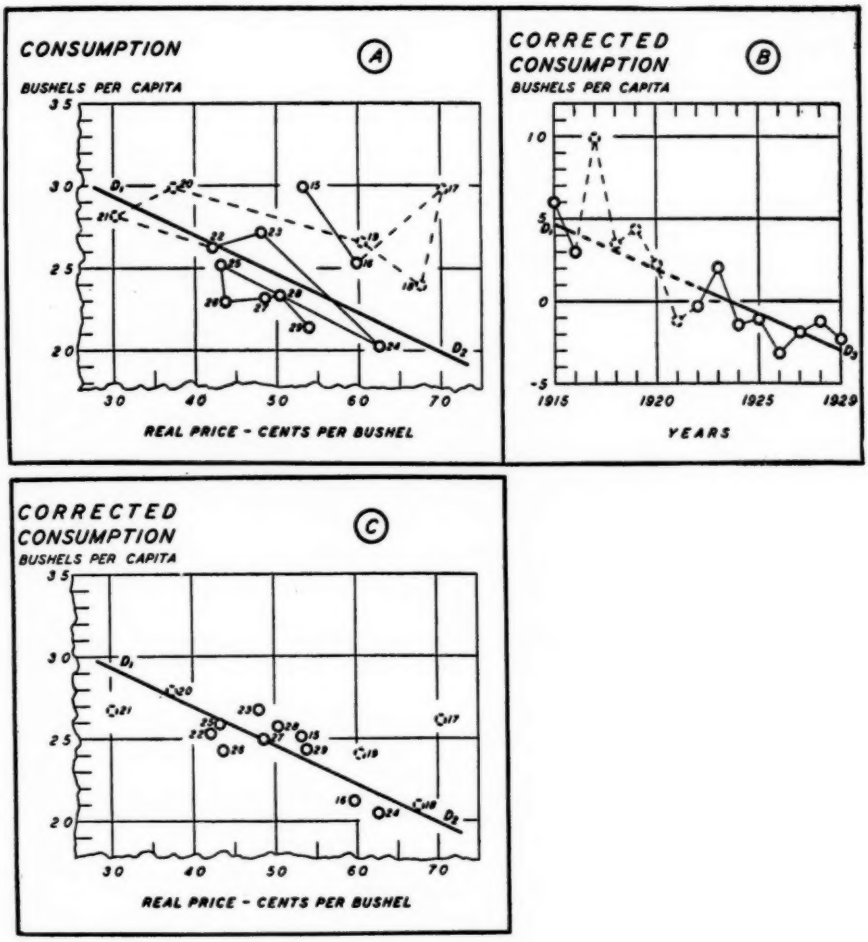


FIGURE 6.—Three aspects of the shifting per capita demand for corn during the period from 1915-1929. (The dotted observations are those which were not used in the computations.)

A.—Relation between the per capita consumption and the real prices when the data are not corrected for the effects of "time," with the demand curve D_1D_2 which results when such correction is made.

B.—Relation between the per capita consumption and time, when the former is corrected for the effects of changes in the real price.

The slope of line D_1D_2, fitted to the corrected data, represents the mean rate of shift of the per capita demand curve D_1D_2.

C.—The per capita demand curve for corn, 1915-29. Line D_1D_2 shows the relation between that part of the per capita consumption of corn in the United States which is independent of time, and that part of the real price which is independent of time.

In the scatter, however, the ordinates, but not the abscissas, have been corrected for secular changes.

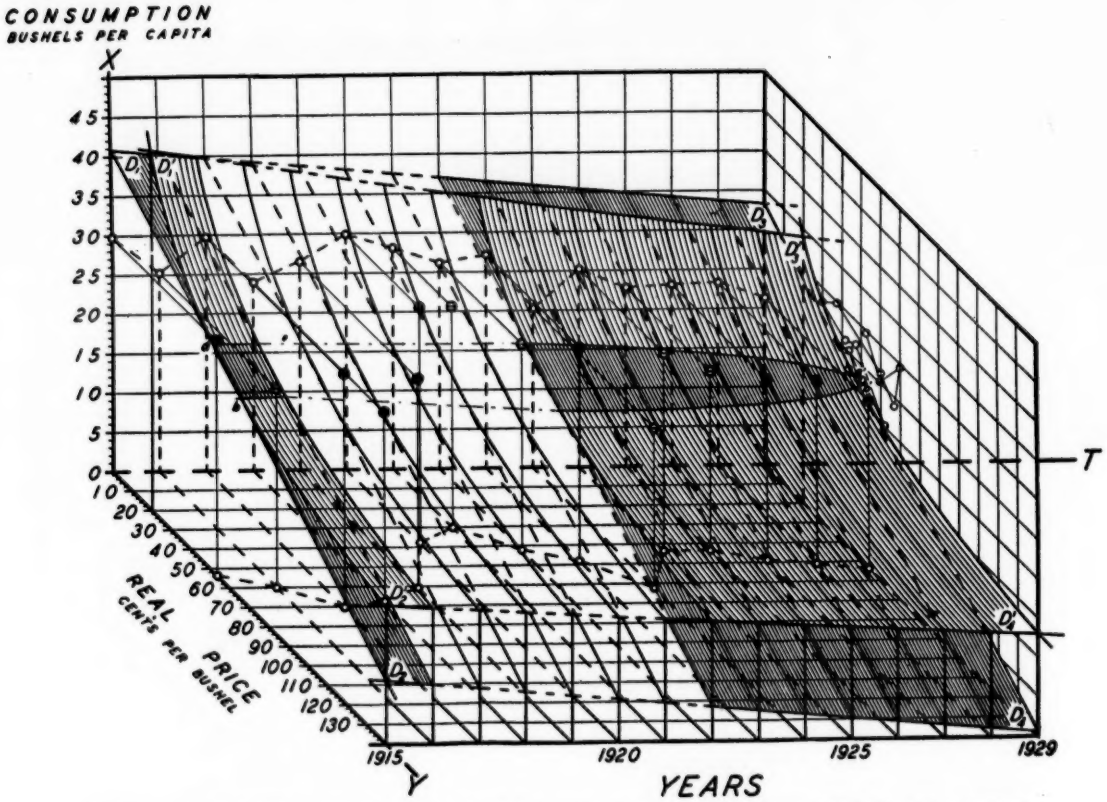


FIGURE 7.—The shifting per capita demand for corn, on two assumptions, 1915-29. (The dotted observations are those which were not used in the computations.)

Figure 4 and Figure 5 relate to the second period. They correspond respectively to Figure 2 and Figure 3 of the first period.

A study of Figure 4B or of either of the two surfaces of Figure 5 shows that during this period the demand curve has shifted upward and to the right at a varying rate.

The equation to the curved surface $D_1'D_4'$—and it is only the curved surfaces which will concern us from now on—is

$$(8) \qquad x = 468.8y^{-(0.6982\pm 0.0663)}e^{(0.0140\pm 0.0027)t-(0.0009\pm 0.0004)t^2}.$$

From it we learn that the relative rate of shift of the demand curve (8) was

$$(8.1) \qquad \frac{1}{x}\cdot\frac{\partial x}{\partial t} = (0.0140 \pm 0.0027) - 2(0.0009 \pm 0.0004)t$$

and that it averaged about 1.3 per cent per annum. That is to say, even if the real price of corn were kept constant, the per capita consumption would probably have increased at this rate. The observed per capita consumption *decreased* at approximately 0.7 per cent per annum.

The equation also tells us that during the second period, the elasticity of demand was –0.70, for

$$(8.2) \qquad \eta_{xy.t} = \frac{\partial x}{\partial y}\,\frac{y}{x} = -0.6982 \pm 0.0663.$$

But this figure is not significantly different from that obtained for the first period (—0.77). We conclude, then, that the elasticity of demand is of the order —0.7, and that there is no conclusive evidence of its having changed during these two periods.

Figure 6 and Figure 7 give the corresponding information for the third period. The dotted circles in Figure 6 and the unshaded area in Figure 7 show the observations which were not included in the computations. The equation to the curved plane is

$$(9) \qquad x = 172.8y^{-(0.4924\pm 0.1563)}e^{-(0.0213\pm 0.0044)t}.$$

From this equation it is clear that during the third period important changes took place both in the elasticity of demand and in the rate of shift of the demand curve. The (numerical) value of the first decreased to 0.49, and the value of the latter dropped from an increasing rate of 1.3 per cent per annum to a decreasing rate of 2.1 per cent. The change in elasticity may not be statistically significant, since the standard errors of these coefficients are relatively large. But there can be no reasonable doubt about the change in the rate of shift of the demand curve.

observations are those which were not used in the computations.)

TABLE 2.—THE SHAPE (ELASTICITY) OF THE PER CAPITA DEMAND CURVE FOR EACH OF THE SELECTED COMMODITIES WITH ITS RELATIVE RATE OF SHIFT AND RELATED CONSTANTS, BY PERIODS, 1875–1929

COMMODITY and PERIOD	EQUATION OF DEMAND x = Per Capita "Consumption"[a] y = Real Price (1913 = 100)[a] t = Time in years beginning July 1, the origin at middle for each period. (Figures preceded by ± are standard errors)	MULTIPLE CORRELATION R^b	QUADRATIC MEAN ERROR (Per Cent) ϵ^c	PER CENT OF VARIANCE ($\sigma_{\frac{x}{x}}^2$) ACCOUNTED FOR BY	
				Price	Time
CORN					
1879–1895[d]	$x = 550.1\ y^{-(0.7749 \pm 0.2100)_e - (0.0032 \pm 0.0040)t}$	0.895	98.4 – 108.2	77.10	3.05
1896–1914	$x = 468.8\ y^{-(0.6982 \pm 0.2071)_e + (0.0140 \pm 0.0027)t - (0.0009 \pm 0.0004)t^2}$	0.944	95.6 – 104.6	106.79	-17.77
1915–1929, (excl.'19–'21)	$x = 172.6\ y^{-(0.4924 \pm 0.1565)_e - (0.0218 \pm 0.0044)t}$	0.869	94.2 – 106.2	18.02	60.87
HAY					
x = Production per Animal Unit					
1875–1892[e]	$(x - 2.2) = 225800\ y^{-(5.7717 \pm 1.0052)}$ (y=-0.72)	-0.821[f]	88.4 – 146.2		
1899–1914[e]	$x = 15.21\ y^{-(0.6853 \pm 0.1598)_e + (0.0026 \pm 0.0036)t - (0.0012 \pm 0.0006)t^2}$	0.821	94.1 – 106.3	60.04	7.46
1915–1929, (excl.'17–'21)	$x = 9.036\ y^{-(0.4312 \pm 0.2046)_e + (0.0224 \pm 0.0040)t + (0.0013 \pm 0.0010)t^2}$	0.932	94.3 – 105.8	13.63	73.03
x = Total Production z = Animal Unit					
1875–1892[e]	$x = 13.57\ y^{-(0.7865 \pm 0.1571)_z + (1.0622 \pm 0.0844)}$	0.959	94.4 – 105.9	5.75	85.80[g]
1899–1914[e]	$x = 10.39\ y^{-(0.6996 \pm 0.1587)_z + (1.1230 \pm 0.2178)}$	0.861	93.7 – 106.7	29.32	44.78[g]
1915–1929, (excl.'17–'21)	$x = 847.6\ y^{-(0.5158 \pm 0.1620)_z - (0.3445 \pm 0.1938)}$	0.838	95.6 – 104.6	45.02	15.21[g]
WHEAT					
x = Per Capita Production plus Imports z = Domestic Exports per Capita					
1875–1895	$x = 9.673\ y^{-(0.1265 \pm 0.1703)_z + (0.4200 \pm 0.0690)_e - (0.0068 \pm 0.0044)t}$	0.833	91.0 – 109.9	-0.44[h]	5.62
x = Per Capita Disappearance					
1896–1913[i]	$x = 5.908\ y^{-(0.0140 \pm 0.1019)_e - (0.0944 \pm 0.0262)\sin\left[(2\pi/12)t + (259°3' \pm 9°42')\right]}$	0.803	94.8 – 108.8	0.38	64.10
1922–1929[i]	$x = 15.03\ y^{-(0.2699 \pm 0.1237)_e - (0.0117 \pm 0.0070)t}$	0.797	95.6 – 104.6	39.09	24.47
SUGAR					
1875–1895	$x = 113.9\ y^{-(0.3828 \pm 0.1224)_e + (0.0156 \pm 0.0044)t}$	0.954	94.4 – 106.0	42.44	48.86
1896–1914	$x = 117.5\ y^{-(0.2717 \pm 0.0844)_e + (0.0124 \pm 0.0022)t}$	0.974	97.4 – 102.7	33.63	61.17
1915–1929,(excl.'17–'21)	$x = 157.8\ y^{-(0.3115 \pm 0.0775)_e + (0.0090 \pm 0.0025)\left[1-(2/3)^t\right]}$	0.960	96.6 – 103.6	49.63	42.47

POTATOES					
1875–1895	$x = 1.0\ y^{-(0.1000 \pm 0.1000)_e - (0.0000 \pm 0.0000)t}$	0.000	100.0 – 100.0	0.00	0.00
1896–1914	$x = 1.0\ y^{-(0.1000 \pm 0.1000)_e - (0.0000 \pm 0.0000)t}$	0.000	100.0 – 100.0	0.00	0.00
1915–1929, (excl.'17–'21)	$x = 1.0\ y^{-(0.1000 \pm 0.1000)_e - (0.0000 \pm 0.0000)t}$	0.000	100.0 – 100.0	0.00	0.00

POTATOES					
1875–1895	$x = 42.57\ y^{-(0.6567 \pm 0.0560)_0 + (0.0057 \pm 0.0026)t + (0.0009 \pm 0.0005)t^2}$	0.947	93.2 – 107.3	86.61	3.01
1896–1914	$x = 8.695(y-35)^{-(0.8702 \pm 0.0281)_0 + (0.0163 \pm 0.0022)t - (0.0016 \pm 0.0005)t^2}$ ($\bar{y}=-0.61$)	0.952	94.9 – 105.4	61.06	29.60
1915–1929, (excl. '17–'21)	$x = 12.04\ y^{-(0.3073 \pm 0.0285)_0 - (0.0015 \pm 0.0056)t}$	0.971	96.3 – 103.9	94.12	0.80
OATS					
x = Production per Animal Unit					
1875–1898[e]	$x = 299.9\ y^{-(0.5667 \pm 0.1225)_0 + (0.0260 \pm 0.0030)t - (0.0018 \pm 0.0006)t^2}$	0.952	93.9 – 106.5	11.91	74.98
1899–1914[e]	$x = 553.5\ y^{-(0.6042 \pm 0.1407)_0 + (0.0027 \pm 0.0051)t}$	0.853	91.5 – 109.3	74.36	-1.64
1915–1929, (excl. '17–'23)	$x = 404.5\ y^{-(0.5592 \pm 0.4649)_0 + (0.0054 \pm 0.0103)t}$	0.703	90.0 – 111.1	55.90	13.52
x = Total Production z = Animal Units					
1875–1898[e]	$x = (10^{-16})1626\,y^{-(0.4808 \pm 0.1219)_z + (26.0646 \pm 5.1910)_0 - (23.9802 \pm 5.1369)(\log z)^2}$	0.979	93.9 – 106.5	-0.03	98.98[f]
1899–1914[e]	$x = 99.87\ y^{-(0.7467 \pm 0.1420)_z + (0.6816 \pm 0.1849)}$	0.858	91.7 – 109.1	42.72	30.62[f]
1915–1929, (excl. '17–'23)	$x = 101.3\ y^{-(0.5073 \pm 0.4802)_z + (0.7153 \pm 0.4472)}$	0.596	90.3 – 110.8	10.03	25.54[f]
BARLEY					
1875–1895	$x = 2.250\ y^{-(0.1585 \pm 0.1197)_0 + (0.0213 \pm 0.0040)t - (0.0007 \pm 0.0007)t^2}$	0.803	90.7 – 110.2	-2.10	69.56
1896–1914	$x = 4.548\ y^{-(0.2151 \pm 0.1142)_0 + (0.0328 \pm 0.0044)t - (0.0036 \pm 0.0008)t^2}$	0.921	91.7 – 109.1	-8.67	93.46
1915–1929, (excl. '17–'21)	$x = 6.391\ y^{-(0.3870 \pm 0.2361)_0 + (0.0069 \pm 0.0098)t + (0.0094 \pm 0.0020)t^2}$	0.902	89.7 – 111.5	9.94	71.48
RYE					
1875–1895	$x = 1.660\ y^{-(0.3605 \pm 0.1755)_0 + (0.0005 \pm 0.0037)t}$	0.436	90.2 – 110.6	18.86	0.06
1896–1914	$x = 2.538\ y^{-(0.4374 \pm 0.1466)_0 + (0.0163 \pm 0.0033)t - (0.0037 \pm 0.0005)t^2}$	0.905	94.0 – 106.4	-2.79	84.61
1915–1929, (excl. '17–'21)	$x = 4264.0\ y^{-(2.4444 \pm 0.4569)_0 - (0.0766 \pm 0.0155)t + (0.0199 \pm 0.0045)t^2}$	0.926	83.4 – 119.9	29.58	56.15
SPRING WHEAT					
1879–1895[d]	$x = 42.48\ y^{-(1.8790 \pm 0.2424)_0 - (0.0061 \pm 0.0047)t + (0.0046 \pm 0.0011)t^2}$	0.905	91.0 – 109.8	45.90	35.95
1896–1914	$x = 2.285\ y^{-(0.5905 \pm 0.3597)_0 - (0.0032 \pm 0.0054)t}$	0.548	90.3 – 110.8	22.92	6.45
1915–1929, (excl. '17–'21)	$x = 7.434\ y^{-(0.9864 \pm 0.3195)_0 - (0.0320 \pm 0.0072)t}$	0.860	92.7 – 107.9	1.91	72.09

[a] For definitions of consumption and price see text.

[b] In comparing the coefficients of correlation, allowance should be made for the different number of parameters in the regression equations on which they are based.

[c] Derived from

$$\epsilon^2 = \frac{[vv]}{n-m}$$

Where [vv] stands for the sum of the squares of the residuals, n the number of sets of observations and m the number of parameters.
Since the equations were fitted in the logarithmic form, ϵ is a logarithm. The figures in this column were obtained in each case by finding the numbers (anti-logarithms) corresponding to $+\epsilon$ and $-\epsilon$, and multiplying them by 100.

[d] Because of their extreme deviations from the rest of the data, the observations for 1875–1878 were not included in the computations.

[e] The U.S.D.A. estimates for the number of horses and cattle in 1899 appear to have been raised in order to conform to the census figures for that year. In view of this change the figures for 1893–1898 appear to be unusually low. Consequently they were omitted from our computations.

[f] Simple correlation between $\log(x-2.2)$ and $\log y$.

[g] Per Cent of Variance in σ_x^2 accounted for by Animal Unit.

[h] Per Cent in Variance in σ_x^2 accounted for by exports = 66.22.

[i] Since wheat is an internationally traded commodity, it seemed advisable to omit the data for the whole war period and the post-war years before trade was resumed on a more normal basis. Therefore, 1914 is excluded from the second period and 1915–1921 excluded from the third.

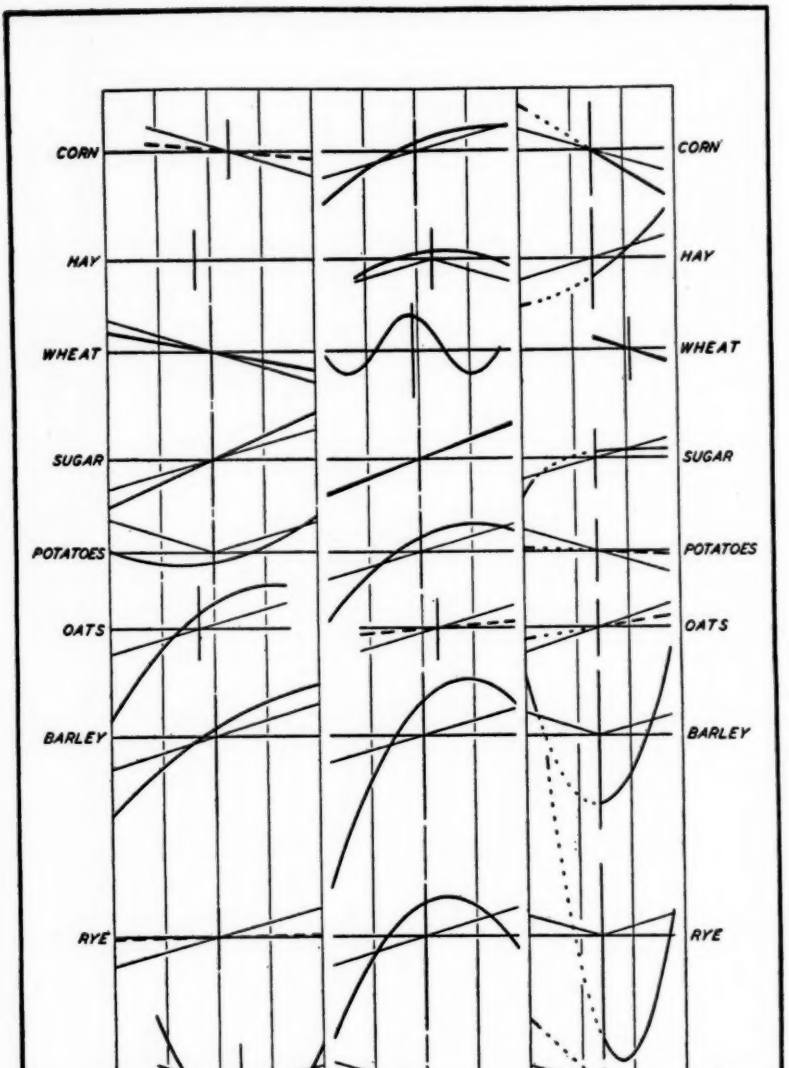


FIGURE 8.—The relative rates of shift of the per capita demand curves for selected commodities, by periods, 1875-1929. (See note 20.)

IV. The Findings

Table 2 brings together the demand equations and the related descriptive constants for the various commodities. Most of the equations are of type (2.1), or a modification of it. They give the shape (elasticity) of the per capita demand curve as well as its rate of shift during each period.

The first three equations, which relate to corn, have already been explained.

The coefficient of multiple correlation is fairly high in each period. The upper range of the quadratic mean error was 8.2 per cent for the first period, 4.6 per cent for the second, and 6.2 per cent for the third. During the first period, price accounted for 77.1 per cent of the variance of per capita consumption, and time only 3.1 per cent. There is a joint contribution by both price and time to the variance of consumption, but it is here divided equally between the two variables and is included in the percentages listed in the last two columns.[18]

But of the two aspects of the various demand curves—their shape and their rate of shift—only the latter concerns us here. Suffice it to say about the former that with the possible exception of buckwheat, the demand for each of the commodities in question is inelastic (or a large crop is worth less than a small crop) and that it has received a fuller treatment in another connection.[19]

Figure 8 is a convenient graphic summary of the rates of shift of the demand curves in question during each of the three periods considered.[20] These curves, which are simply the graphic representations, on a logarithmic scale, of the exponent of "e" in demand equations (2.1) or 2.2), show the smoothed or *average* rates of shift; the observed rates fluctuate about these curves. All the curves show the relative changes in the *per capita* demand, except those relating to hay and oats, which represent the changes in the demand per *animal unit.* The animal unit series is a weighted index of the number of milk cows, of other than milk cows, and of horses and mules for each year, the

---

[18] For an explanation of these "coefficients of determination" and for an interpretation of the negative signs of such coefficients, see the following: Mordecai Ezekiel, *Methods of Correlation Analysis*, New York, 1930, Note 11, pp. 381-83, and the references therein given; S. Krichewsky, *Interpretation of Correlation Coefficients*, Physical Department Paper No. 22, Government Press, Cairo, Egypt, 1927, p. 10; and Henry Schultz, *Statistical Laws of Demand and Supply*, pp. 171-75.

[19] "A Comparison of the Elasticities of Demand for Selected Commodities, Obtained by Different Methods," read before the Joint Meeting of the American Statistical Association with the Econometric Society, December 29, 1931. To be published in an early issue of *Oekonometrika.*

[20] The upward or downward slopes of the straight light lines indicate shifts in demand of one per cent per annum. Dotted lines indicate that the rate of shift is less than its standard error, and hence not statistically significant.

weights being the consumption of the commodity (hay or oats) by each of these groups respectively in 1914. (See U.S.D.A. Farmers' Bulletin No. 629, p. 9). Since large proportions of the hay and oats crops are consumed directly by animals, it seemed logical to use such an index rather than population figures as the deflator.

The three top curves relate to corn. Their characteristics have already been described. *They are the $D_1'D_3'$ curves of Figures 3, 5, and 7, plotted on a logarithmic scale.* (On such a scale the slope of $D_1'D_3'$ = slope of $D_2'D_4'$).

The second set of curves shows that the demand curve for hay (when demand is expressed in terms of tons per animal unit) remained fixed during the first period, shifted first upward and then downward during the second, and showed a tendency to shift upward again during the third period.

Coming to wheat, we must first observe that there are no estimates of stocks for the first period. The diagram shows that during this period there was a downward shift in the per capita production plus imports, when allowance is made for changes in per capita exports and in real prices. If the stocks of wheat were sensibly constant during this period, the conclusion would probably also apply to disappearance. During the second period, the relative shift of the per capita demand was subject to more or less well-pronounced cyclical fluctuations. This should not, however, be taken as indicative of an underlying rhythmical movement in the demand for wheat, for when account is taken of the several factors entering into disappearance—exports, beginning and ending stocks, and seed requirements—the time variable becomes insignificant. During the third period, the shift was downward at approximately 1.2 per cent per annum.

The per capita demand curve for sugar shifted upward at the rate of 1.56 per cent per annum during the first period, at a somewhat lower rate (1.24 per cent) during the second period, and reached a standstill in the latter part of the third period.

The demand curve for potatoes began shifting upward toward the end of the first period,[21] continued its upward shift, but at a decreasing rate, during the second period, and came to a standstill in the third period. (The slight downward shift is not significant.)

The demand curve for oats (on a per animal unit basis)

[21] The left branch of the parabola does not satisfactorily describe the underlying movement of the data.

showed a marked upward shift during the first period. Its slight upward shifts during the second and third periods are not significant.

The quantity and the price series for barley show many internal inconsistencies and their year-to-year fluctuations are probably subject to very large margins of error. Taken at their face value, they show that during the first period, the per capita demand curve shifted upward at a decreasing rate, the average being approximately 2.1 per cent per annum; that during the second period, the shift was first upward and then downward, the turning point being at 1910 or thereabouts; and that during the third period the shift was first downward and then upward.

The demand curve for rye had no upward or downward shift during the first period. During the second and third periods, however, its movements resembled those of the demand curve for barley.

The path followed by the shifting demand for buckwheat during the first period was u-shaped. During the second period, there was no significant shift. During the third period, the shift was downward at the rate of 3.2 per cent per annum.

Interest naturally centers on the changes that have taken place in the demand for these commodities during recent years. A glance at Figure 8 brings out the interesting fact that during the last period the demand curves for all but three of the commodities have either ceased to shift upwards (sugar) or have shifted downwards. The three possible exceptions are hay, barley, and rye. The upward shift in oats, as noted above, is not significant.

But the positive slope of the curve for hay, although it is statistically significant, does not necessarily prove that the demand per animal unit has shifted upward during this period. There are at least two ways of allowing for the effects of changes in the number of animal units: (1) to divide the total consumption by the number of animal units, or (2) to introduce the number of animal units as an additional variable in the demand equation, i.e., to write total consumption (x) as a function of the number of animal units (z) as well as of price (y) and time (t):

$$x = Ay^{\alpha}z^{\beta}e^{\gamma t}. \tag{10}$$

When this second procedure is adopted, the coefficient γ turns out to be practically zero, which means that there is no evidence of an upward or downward shift of demand; or that the catch-all, "time," disappears as a factor in the study of demand. This is

true also for the first and second periods. The resulting equations are also shown in Table 2.

For the first two periods, the equations with z as an explicit variable give a considerably better description (as judged by R and ϵ) of the factors affecting the demand for hay than that obtained from the equations in which time is an explicit variable. For the third period, however, the description is not so good. When we recall, however, that the number of animal units is based on estimates of animal consumption of hay for the one year, 1914, and that it is probably subject to a large margin of error, we shall be justified in questioning the significance of the apparently upward shift for the third period, in spite of the fact that the demand equation in question gives a good description of the data.

The demand curves for barley and rye did not shift upward during the entire third period, but only during the last half of it (1922-1929). The explanation of this phenomenon is probably to be sought in the demand interrelations among the various crops, which have not as yet been studied. In any event, it is very doubtful whether the demand for these commodities is going to continue to shift upward.

V. *Conclusions*

1. Throughout the vast field of economics there are but few abstractions that are more common, more valid, or more useful than elasticity of demand, and the shift of the demand curve. Yet even these abstractions are still imperfectly represented by vague words and are still more rarely stated in quantitative, statistical terms.

2. The important feature of this investigation is that it attempts to give these concepts an approximate statistical significance. It is approximate because it depends not only upon the inaccuracies and incompleteness of the underlying data, but also upon deliberate neglect of variables that are known to be involved in demand phenomena, such as the effects of substitutes, changes in income, etc. Furthermore, even such variables as have been taken into consideration have not been described as fully as they might have been. In a first attack on such a difficult problem as the shift of demand, such simplifications are very desirable, if not indispensable.

3. If we accept the data at their face value, the conclusion emerges that the per capita demand curves of those farm crops

of which corn, hay, wheat, sugar, potatoes, oats, barley, rye and buckwheat constitute a fair sample, have either ceased to shift upward or have begun to shift downward. The only upward shift in demand to be expected in the near future is that due to the normal increase in population. But the rate of increase of our population has been decreasing. Our population is rapidly approaching its upper limit.

4. The secular decrease in the rate of shift of the per capita demand for these commodities is probably due to physiological causes. The shift of the population from country to city, the increasing use of the automobile, and the growing proportion of old people in the population—factors which have been at work for several decades—all have favored a smaller consumption of calories per capita. This has had an effect on the demand for the heavier nitrogenous foods.

5. This decreasing per capita demand for some of the basic crops, coupled with the significant technical changes which American agriculture has witnessed since the war and which will probably lead to a veritable agricultural revolution, suggest that in the future we shall need relatively fewer farmers and probably fewer farms. Agriculture will have to adjust itself to these conditions or to seek outlets in foreign countries.

THE EFFECT OF A BUSINESS DEPRESSION ON THE DEMAND FOR LIVESTOCK PRODUCTS AND THE OUTLOOK FOR THESE PRODUCTS.[1]

WARREN C. WAITE
UNIVERSITY OF MINNESOTA

Slightly over half of the gross cash income of American agriculture arises from the sale of livestock or their products. The estimate by the Bureau of Agricultural Economics for 1930 is 56.2 per cent of the total. This proportion, of course, varies widely with the type of agriculture in different sections. The lowest proportion is found in states such as Alabama and Florida with approximately 12 per cent of the cash income from livestock, and reaches 80 per cent or more in such states as Minnesota, Missouri, and Nevada. The South is the only large section where livestock and their products are not a principal source of cash income.

When we compare the situation in livestock with that of crops, we are struck by the much greater importance of the foreign market in the latter. We export virtually no mutton, wool, or beef. In recent years, we have about struck a balance between our exports and imports of dairy products, when we reduce them to a milk equivalent basis. It is only in the cases of pork and lard that we maintain any appreciable export trade, and this has shown a tendency to decline. In terms of pounds, pork exports have declined from about 25 per cent of our total production, a peak reached in 1919, to less than 5 per cent of total production at the present time. Exports of lard still remain close to 30 per cent of total production, although they too have declined from the peak of over 40 per cent reached in 1921. We find quite a different situation in our principal cash crops; cotton, wheat, and tobacco. About 50 per cent of our total cotton production is exported, 35 per cent of our tobacco and 20 per cent of our wheat. Thus, our important cash crops are much more directly influenced by foreign conditions than livestock and their products. Aside from pork and lard, these foreign situations, in view of our high tariffs, will be generally unimportant except as they influence domestic business conditions.

We consider first, in consequence, changes in the domestic demand for livestock and their products. The usual price analysis

[1] Paper read at a joint session of the American Statistical Association and the American Farm Economic Association at Washington, D.C., in December, 1931. Published with the approval of the Director as Paper No. 1073 of the Journal Series of the Minn. Agr. Exp. Sta.

is primarily interested in determining the elasticity of demand for the product, and changes in demand ordinarily appear as trends eliminated in the course of the analysis. For example, a correlation is computed in which price, supply, and time are treated as separate variables. The trends of price and supply jointly are then taken to indicate the changes in demand. For our purposes a somewhat more flexible method is needed, so we reverse the process, endeavoring to eliminate the price-supply relationship and leave the remainder as an index of the change in demand. In order to compute these indexes it is necessary to make certain simple, although extremely bold assumptions. The first is that the commodity has a certain known elasticity of demand, and that this elasticity is constant at all prices. We naturally turn to the numerous existing studies of the relations of price and supply of the specific product for an estimate of the numerical elasticity to be assumed. The second assumption is that the elasticity remains unchanged through the various shifts or changes in demand. We thus assume, for example, that the elasticity of demand is the same in periods of prosperity and depression, and all that takes place is a general shift in the entire curve.

On the basis of these two assumptions we are in a position to compute changes in demand from our price and quantity data and express these changes as indexes. The process of computation can be seen most easily if we convert to logarithms our data on quantities and prices. We know that demand curves of uniform elasticity are straight lines when plotted upon double logarithmetic paper, while the slope of the line is equal to the elasticity. Moreover, we know that equal distances on logarithmetic scales are equivalent to equal percentages. With these two characteristics in mind, let us examine the two demand situations in Figure 1, where the elasticity is one, and the second demand curve is 1 per cent higher than the first. Selecting some point representing a given price and quantity on the first curve, we see that a point on the new curve might be represented by a variety of new situations, roughly an increase of 1 per cent in the quantity taken at the old price, or an increase of 1 per cent in price for the old quantity, or an increase of 2 per cent in price with a decrease of 1 per cent in the quantity taken. In the case of our curve with an elasticity of two, we also see that a variety of circumstances may represent a point on the new curve. For example, an increase of 1 per cent in price for the old quantity, a 2 per cent increase in quantity at the old price, or a 4 per cent

increase in quantity at a 1 per cent lower price, all roughly indicate some point on the new curve. We may thus calculate from a given price and quantity change, how much the demand curve must have shifted provided we assume the elasticity is known and remains the same in both curves. The indexes which follow have been computed by percentage changes from the base; the percentage increase or decrease in price added to the reciprocal of the elasticity times the percentage increase or decrease in quantity. The technique of computation might be refined, but we have preferred to keep our assumptions as simple as possible. These will serve to throw the situations into strong relief, and it is doubtful that any important conclusions would be modified.

The first indexes of demand which we examine are those computed from annual averages of consumption and retail prices. The estimates of per capita disappearance made by the Bureau of Agricultural Economics, and annual average retail prices reported by the Bureau of Labor Statistics are readily available for wheat-flour, cornmeal, sugar, pork, beef, lamb, lard, butter and cheese. The prices have been deflated by the Bureau of Labor Statistics Retail Food Index. The base is the average of the period 1910-14. We may interpret such an index to represent the relative prices which would have been paid in various years throughout the period for a constant annual per capita quantity. In so far as there have been significant changes in quality or changes in retail services during the period, our indexes are rendered less effective.

Examination of these indexes discloses no very marked changes in the per capita demands during the period from 1900 to 1918. There were some general trends, the demand for wheat-

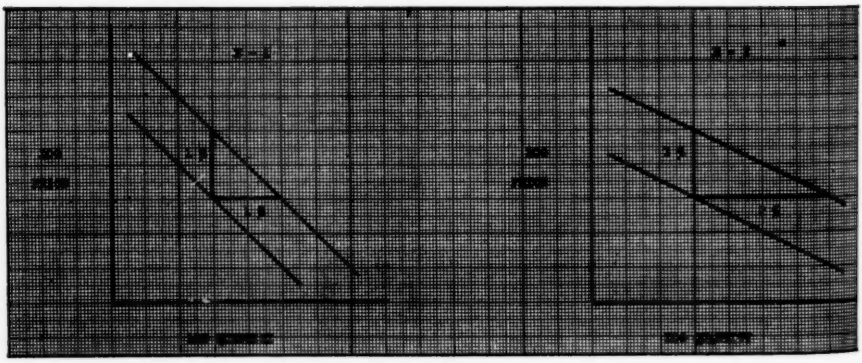


FIGURE 1.—Shifting of demand curves with constant elasticities of one and two.

flour and cornmeal declined steadily throughout the period and the demand for pork rose gradually. The period from 1918 to about 1922, however, was apparently one of tremendous change, probably greater than at any previous time. Many factors contributed to this change. We emerged from the restrictions of the war, prohibition was ratified, we were assailed with propaganda regarding proper foods, and probably more important, the real earnings of wage earners increased greatly. The increase of real wages in this short period was greater than in the preceding thirty years. There was a very great increase in the demand for sugar, pork, beef, lamb, and dairy products, together with considerable declines in the demand for wheat-flour and cornmeal.

TABLE 1. INDEXES OF RETAIL DEMAND IN THE UNITED STATES FOR CERTAIN FOOD PRODUCTS[1]

Year (calendar)	Cornmeal	Wheat Flour	Pork	Beef	Mutton Lamb	Lard	Butter	Cheese	Evaporated Milk	Sugar	Oleomargarine
1910	107	103[2]	96	97	—	111	—	—	—	93[2]	—
1911	95	95	102	97	—	94	—	—	—	98	—
1912	112	94	95	98	—	93	—	—	—	99	—
1913	88	109	104	106	101	99	—	—	—	100	—
1914	96	98	102	105	99	103	—	—	—	113	—
1915	111	129	93	101	98	105	—	—	—	99	—
1916	86	113	94	96	96	116	100	100	—	105	—
1917	132	100	87	90	85	122	91	95	—	85	—
1918	118	96	105	104	90	142	90	91	—	91	—
1919	105	124	103	95	92	133	101	116	100	149	100[2]
1920	110	70	97	87	89	108	94	105	71	152	75
1921	100	65	107	93	106	72	102	113	99	120	52
1922	84	86	115	98	125	99	105	124	104	152	54
1923	86	90	121	99	117	110	120	139	105	146	63
1924	78	89	122	102	119	117	115	145	106	154	57
1925	99	77	121	96	114	109	114	143	105	137	58
1926	88	64	122	99	115	103	112	144	99	132	57
1927	92	88	123	103	119	99	117	143	102	135	63
1928	93	86	127	115	123	105	118	146	108	151	69
1929	95	76	128	120	124	98	112	130	108	110	69
1930	—	—	123	117	121	102	102	141	110	—	—

[1] The base is 1910–1914 for cornmeal, wheat flour, pork, lard, beef and sugar; 1913–1914 for mutton-lamb; 1916 for butter and cheese; and 1919 for evaporated milk and oleomargarine. Elasticities of demand of one are assumed for all products, except flour and sugar for which one-half was used, and beef and mutton for which two were used.

[2] Year begins July 1.

It is significant that these shifts in demand appear to have been completed largely by 1923 or 1924. The increases then ceased and some commodities even showed declines, for example, sugar and lard. The latter part of the decade was one of fairly constant relationships, few of the commodities showing changes as marked as in the preceding five years. The correlations between the Douglas index of average annual real earnings and the changes in demand for livestock products during this 20-year period are around +.80, except for beef and lard. Moreover, the regression coefficients of demand on income are about +1.0. It is not at all certain that the demand for these products will permanently decline if we should have a lowering of the real in-

comes of laborers, but we may be fairly certain that we can expect no marked increases in per capita demand unless we again have a considerable increase in these real incomes.

We are able to examine changes in the demand for livestock products during the period from 1921 to 1931 in somewhat greater detail. For this period we have monthly estimates of the amounts of federally inspected meats apparently available for consumption. We may use these as an index of total consumption since it is probable that the consumption of meats not federally inspected fluctuates approximately with that of meats federally inspected. We construct an index of demand following our earlier method, which compares each month as a percentage of the same month in the preceding year. Some allowance is thus made for a seasonal variation in demand, and we increase the probability that our data are comparable. These indexes differ from the earlier ones in the use of total quantities rather than per capita amounts. The growth of population within a year would not be sufficient to make an appreciable difference. We also use central wholesale market quotations in this comparison and deflate these prices by the Bureau of Labor Statistics Wholesale Price Index.

The indexes for beef, pork and lamb are shown in Figure 2. There is no continuous increase in the demand for these products, but instead alternate periods of strength and weakness. Moreover, the demands fail to fluctuate together, and there is strong indication of a negative correlation between the demand

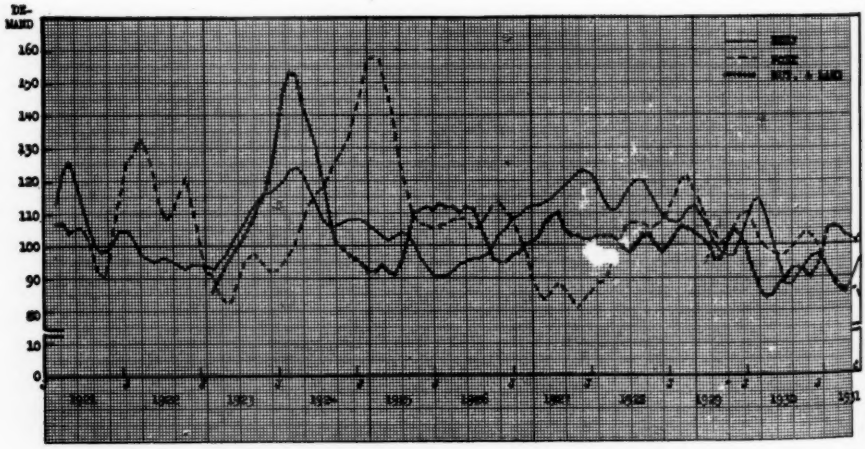


FIGURE 2.—Per cent which the demand for particular meats is of the demand in the corresponding month of the preceding year, for the United States, by months, 1921-31.

for beef and pork. The periods of weak demand for pork appear to have been periods of strong demand for beef and the periods of strong demand for pork appear to have been periods of weak demand for beef. It appears that these two meats are highly

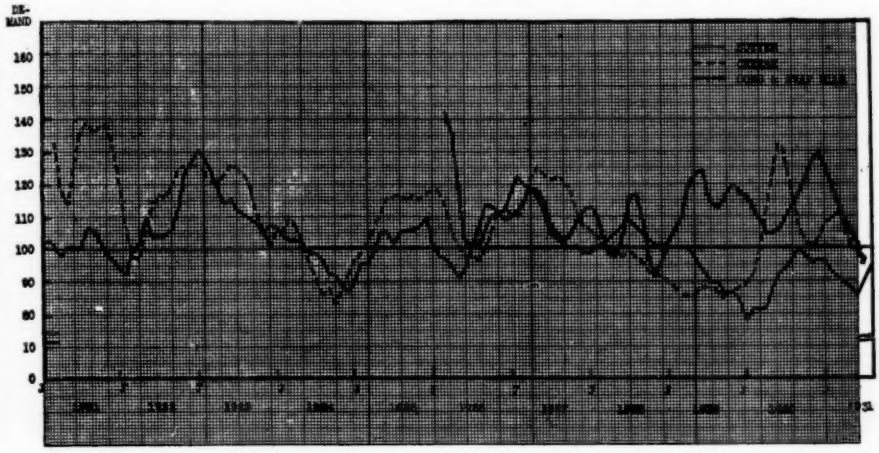


FIGURE 3.—Per cent which the demand for selected dairy products is of the demand in the corresponding month of the preceding year, for the United States, by months, 1921-31.

competitive. The demand for lamb shows a tendency toward fluctuations similar to those of beef rather than pork. The shifts in the demand between pork and beef are not associated with business fluctuations in this short period. They follow, instead, periods of unfavorable price relations for one of the products.

In the present depression, the demand for both beef and pork lessened somewhat during the break in October, 1929, then recovered during the early part of 1930. The demand for beef remained strong for several months after pork had declined but later fell somewhat further, and by the middle of 1931, both were at a very low point.

Similar indexes have been computed for butter, cheese and condensed milk. (Figure 3.) We are unable to compute one for fluid milk because of the lack of data. The demand for butter shows a high correlation with changes in business activity through the period. This does not seem to have been as true of cheese. A marked decline in the demand began in early 1928 and has continued through the period of the depression. In contrast, the demand for evaporated milk appears to have remained strong, and even to have increased during the early depression

period. One reason which may be suggested is the decline in price of evaporated milk relative to the price of fluid milk in many cities. In New York, the ratio has changed steadily, for example, from 1.1 in 1930 to 1.7 in 1931. This change in ratio has produced an increasing advantage for the consumer to switch from fluid to evaporated milk, and the tendency has probably been increased by the lower incomes. We are well aware that this substitution is greater on low than on high income levels, which leads one to suspect such a shift to be a cause of the relatively stronger demand.

A further suggestion arises from an examination of the changes in the demand for butter. Our index declines early in 1929 while the indexes of business activity and payrolls show recessions sometime later. A similar situation occurs in 1920. This is not true of the minor breaks in 1924 and 1927 when demand fluctuated about with payrolls. It is more difficult to examine earlier periods well, since data on storage stocks and production are lacking. Examination of the period of 1906-08, 1912-14, and 1892-94 on the basis of the receipts of butter and prices at the New York market indicates a similar situation in these earlier depressions. One is thus led to the conclusion that it is probable that changes in the demand for certain food products may take place before changes in business and incomes of workers become recorded in our indexes of payrolls and business activity. This has been a most annoying circumstance in the analysis undertaken here, but may be one which business forecasters will do well to consider.

We are now in a position to point out certain salient features of the long time outlook for demand in livestock products. We have sufficient evidence to warrant the assumption that increases in the income of laborers will result in an increase in the per capita demand for these products, and that for a number of these products this increase in demand may approximate for some time the increase in incomes. Moreover, we must depend to a greater extent on increases in per capita demand for a total increase in demand, since a lower rate of increase of population will lessen the growth of demand from that source.

Butter appears to hold the key position in the dairy situation. There are strong indications that we are approaching a considerable expansion in our production of dairy products. It is difficult to see how the dairy industry can expand production without forcing more butter into consumption. If our assumption

regarding the elasticity of demand for butter is correct, increases in production will not even bring larger gross sales in dollars unless there is an increase in demand. We should not be misled by the higher prices of butter during the fall months. Our index of demand indicates that these resulted almost entirely from unusually small production. It is probable that the dairy industry may look for more intense competition from oleomargarine and vegetable oils during the next decade. This is the most serious sort of competition for the industry, since the displacement of a pound of butter frees something like twenty-two pounds of milk for other uses. It appears impossible for other uses of milk to increase in demand sufficiently rapidly to offset any considerable decline in the demand for butter.

On the other hand, there are certain favorable factors in the situation. Butter is consumed largely by adults, and the change in age composition of the population as our rate of increase lowers, leads toward a possibility of a somewhat larger per capita consumption. Moreover, there are indications that our urban rates of fluid milk consumption may be increased. When we compare the milk drinking of city and rural children, we do not find the decline in the number drinking milk as the age group increases to be nearly as marked among the city children. It is only in the adult group that there is a marked decline. It thus appears that city children have been encouraged to drink larger quantities of milk and there is promise that these habits will be carried over into adult life. This will help materially toward the maintenance of a high rate of urban consumption of fluid milk.

The most difficult feature of the meat situation lies in the decline in the foreign demand for our lard. In view of the serious situation in the European market, it does not appear likely that a recovery is possible in the near future. Moreover, the South is an important factor in our pork consumption. The correlations between the value of the cotton crop and demand for pork are fairly high. A marked increase in the demand for pork appears to wait on the recovery of prosperity in the South. This recovery in turn has a large dependence upon conditions in other parts of the world, particularly Europe.

We have seen that there is a considerable relationship between the prices of pork and beef. High prices for beef cannot be maintained in the face of low pork prices. The unfavorable elements in the pork situation must be transmitted at least in part to the beef situation.

The outlook for livestock products can hardly be considered adequately from the standpoint of demand alone. We must give at least passing consideration to some of the supply aspects. Let us first consider the current situation. We find feed ratios to be favorable. That is, the prices of feed grains have fallen lower than the prices of livestock products. Further examination discloses that this is not a unique situation but appears to be typical of most of our great depressions. In Figure 4 we compare the three-year moving average of the ratio of feed to livestock product prices, comparing the price of three pounds of grain with the composite price of butter, pork and beef produced from three pounds of grain.[2] It will be observed, disregarding certain trends which are not essential to our present problem, that the curve reaches low points in the present depression, the periods of 1920-21, 1913-14, the 1890's and 1883-86. These are the periods of relatively profitable feeding. Such favorable feeding ratios tend to increase the production of livestock products. Those types of livestock that are expanding tend to have the rate of increase accelerated. Those types which are declining tend to have the rates of decrease lessened.

We appear to have worked into a fairly satisfactory situation with respect to stocks in storage or in process for most livestock products. The comparison of stocks with the current movement into consumption is probably the most valid comparison which we can make for stocks, since stocks are large or small largely with reference to the time which it will take to consume them at current rates of consumption. In the case of pork, beef, lard, cheese, and butter, we find the amounts in storage considerably below the average of recent years.

Our productive capacity in terms of numbers of animals is on the increase. Beef cattle numbers began to increase in 1928. The rate of increase has been slower than in the previous cycle and has taken place largely in the western corn belt rather than in the range states. Milk cows have also been increasing since about 1927 and there are indications that the increases have been somewhat greater this year. Moreover the increase has been general extending even to the North Atlantic States in which the number had previously declined for a considerable number of years. Sheep numbers are now large and a considerable liquidation is probable during the next few years. The decline is

[2] I am indebted to Prof. L. F. Garey of Minnesota for the construction of this ratio and for permission to use it.

expected largely in the range states with but slight declines in the general farming areas. It is evident that increased production and marketings are close at hand in all branches of the livestock industry.

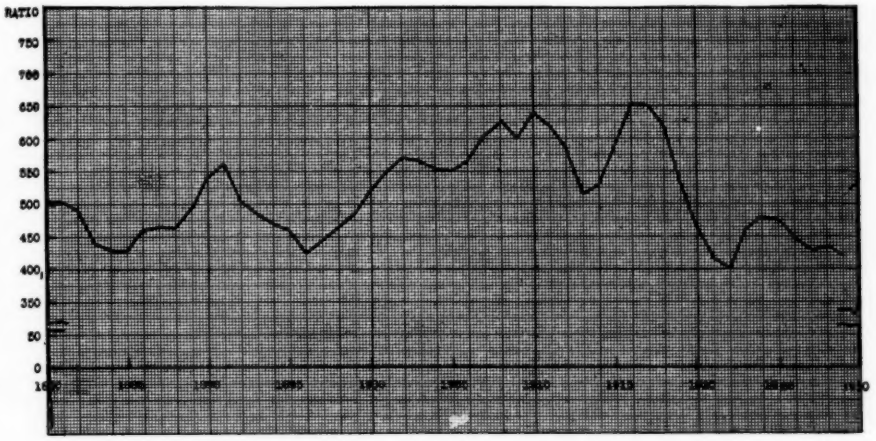


FIGURE 4.—Three year moving average of the ratio of the composite price of three pounds of corn, oats, and barley to the composite price of the butter, pork, and beef produced from three pounds of grain.

There is a final element in the situation which we must consider. This is the possibility of change in the margin between the producer and retail price. A little reflection makes it evident that a reduction in the margin equivalent to 1 per cent of the retail price would produce the same result as a 1 per cent increase in retail demand with the old margin. It is not probable that reductions in margins will be rapid enough to overcome declines in retail demand while these declines are taking place. We are well aware that these margins contain large elements of fixed charges. As we reach the low point of retail demand, however, these margins may be expected to show some reduction and our producer demand will show some increase, even though the retail demand remains low. This is one reason why our indexes of demand on the basis of wholesale prices sometimes show increases before the end of the depression period, or even before the increases of the indexes of factory payrolls. Decreases in margins may be expected to result only partially in regaining the position lost through a decline in consumer demand. In order to offset completely such a decline in demand the margin would necessarily

decrease in absolute amount as much as the decline in retail price.

We may summarize the outlook about as follows: It is evident that we may expect no increase in consumer demand until consumer incomes improve. It is probable that an increase in demand will follow these changes in income about proportionally. It does not appear that the elements essential for a rapid recovery are present in the current situation, and our best prospects are for a gradual recovery. Producer demand, however, may be expected to show increases earlier than these increases appear in consumer demand because of reduction of margins. The early part of the depression will probably be the period of the lowest producer demand. Some gains have already appeared from the narrowing of margins. If it were not for increased volume of production, we could look forward toward improvement with some confidence. Marketings in all lines of livestock products may be expected to show increases during the next few years. This will result in unfavorable feeding ratios and difficulties for producers other than the more efficient. It is difficult to believe that demand can increase rapidly enough to prevent these situations.

INDICATIONS OF CHANGES IN THE DEMAND FOR AGRICULTURAL PRODUCTS[1]

E. J. WORKING
BUREAU OF AGRICULTURAL ECONOMICS

Two types of studies have been carried on and are currently being carried on in the Bureau of Agricultural Economics which provide indications of changes in the demand for agricultural products. One of these types consists of our price analyses. The other consists of our consumption analyses. Since more studies have been made of factors affecting price than of factors affecting consumption, the bulk of the evidence which we have of changes in demand is to be gained from the price analysis studies. All of these studies give interesting and valuable evidence concerning changes in the demand for the products with which they deal. Unfortunately, however, few of them, mostly the earlier ones, have been published.

As Professor Schultz has discussed at considerable length the changes in demand for nine different crops including all the more important ones except cotton, I shall not burden you with a detailed discussion of just what our studies indicate concerning the demand for these crops. Instead I shall confine myself to a discussion of how price analyses such as we have made may be interpreted in terms of shifts of demand and to a discussion of some general indications of shifts in the demand for agricultural products as a whole.

I suppose that many of the members of these associations are familiar with those of the Bureau's price analysis studies which have been published, especially the studies of Bean, Ezekiel, Haas, and Smith. Those who are familiar with such price analyses, however, may not have thought of them as measuring shifts and trends in the demand of the commodities in question, yet these studies do include such measures. Furthermore, the fact that such studies have been designed to disclose and measure the importance of factors affecting price, does not ordinarily significantly hamper their usefulness for measuring changes in demand. Indeed if the purpose of a price analysis is to provide a complete explanation of the changes in price of the commodity

[1] This paper was read at a joint meeting of the American Farm Economic Association and the American Statistical Association, Washington, D.C., December 30, 1931. The author is indebted to the numerous workers in the Bureau of Agricultural Economics who have made studies relating to the demand for agricultural products. Mr. L. H. Bean, Mr. Carlos Campbell, and Mr. G. B. Thorne, in particular, have aided in the preparation of the present paper.

with which it deals, it is more likely accurately to indicate changes in demand than is a study which provides a less complete analysis of changes in price or consumption even though the latter may be undertaken specifically to measure demand.

In order to avoid any possible misunderstanding, I should, perhaps, give notice that throughout this paper I am using the term *demand* in the *schedule* sense, not in the *market* sense or in the *elasticity* sense.

There is another question of definition which must be considered. Suppose there has been a decrease in the money price at which a given quantity of a commodity will be taken, but, when price is expressed in terms of the exchange value of commodities in general there has been no change in it. Has there been a decrease in demand or not? It may be maintained either that demand should be measured in terms of quantities and money prices, or in terms of quantities and "real" (deflated) prices. As I have already indicated, I consider the matter largely one of definition. Either concept is a perfectly tenable one, but the distinction between the two should be clearly recognized and it is necessary to bear in mind which of these definitions is being used in any particular analysis. One's preference between them may depend largely upon the view which one may hold as to whether changes in the general price level are a direct reflection of changes in the value of money or whether they are the result of all the changes in prices of individual commodities, each of which is largely independently determined.

Over long periods of time, during which there have been marked changes in the general price level the concept of demand in terms of the relation between quantity demanded and a deflated price (exchange value in terms of commodities in general) is the most generally useful. Over short periods of time, however, it is quite likely to be desirable to analyze changes in the demand for a commodity in terms of money prices rather than in terms of deflated prices.

The use of money prices rather than deflated prices may also be desirable for a period during which there has been no significant upward or downward trend in the general level of prices. Under such conditions, fluctuations in the average level of prices may be thought of as being the net result of changes in the prices of all individual commodities, these in turn being caused, in so far as they do not counterbalance each other, by what may be termed "the self-generative forces of the business cycle." Even

in a period such as that of the past two years when the general level of prices appears to have reacted under the influence of conditions outside of those which may be termed "the self-generative forces of the business cycle," it may nevertheless be held that the fall of prices is brought about *through* the effect of changing demand upon individual commodities, and that in order to get the full significance of the course of events it may be desirable to study the changing demand for the individual commodities in terms of the relationships of quantities demanded and money prices rather than deflated prices.

With these preliminary considerations out of the way, we may proceed to the more detailed question of the determination of changes of demand.

The prime requisite to the measurement of shifts in a demand curve is the determination of the approximate nature of that demand curve. Once the average demand curve is approximated it is a very simple matter to measure the principal shifts which have taken place in the curve, *provided* there has been no substantial change in the elasticity of demand and provided that the data of price and quantity demanded are representative and accurate for the market to which the demand curve applies.

An article which I wrote some five years ago has, I fear, been interpreted by some people to mean that I do not consider it possible to determine statistically the nature of a demand curve of a commodity. On the contrary, my belief is that by the careful, painstaking analysis of statistical data in the light of economic theory and of a thoroughgoing knowledge of the commodity in question, it is possible to approximate a demand curve for that commodity.

Please note that I have said that it is possible to approximate *a* demand curve, not *the* demand curve for the commodity. Much confusion and error have resulted from the very common idea that for any given commodity and for any given market area there is one and only one demand curve. Distinctions are to be drawn between dealer demand and consumer demand, between demand at wholesale and demand at retail, between demand for consumption and demand for storage, between demand for a rate of flow of a commodity and demand for a stock of a commodity. But it is not these distinctions which I now have in mind. It is rather the distinction between market demand curves, short-time normal demand curves and long-time normal demand curves. The increase in the rate of consumption of a commodity which re-

sults in a given year from a price 50 per cent below normal must not be assumed to be the same as the increase in the rate of consumption which would result if prices were maintained at a similarly low level for a period of ten years.

It is my belief that statistical analyses, properly carried out can in the case of many commodities be made to yield an approximation of some sort of short-time normal demand curve. But it should not be assumed that long-time normal demand curves can be approximated with similar success. The principal statistical evidence which we have of the nature of long-time normal demand curves consists of trends of prices and consumption. Thus if the trend of deflated price of a commodity is upward over a period of years and the trend of its consumption is downward and if there has meanwhile been no shift in the long-time normal demand curve, we can determine the nature of a section of this normal curve from these data. The trouble is, however, that we do not have satisfactory evidence that there has been no trend in the conditions of demand. If there has been a gradual shift in the long-time normal curve, we do not have the means to determine just how much of the trends of consumption and price are due to the changing conditions of demand and how much to the shift of equilibrium to a different point on the demand curve. Much the same thing is true in the case of evidence from cyclical changes in the consumption and price of a commodity, though if enough

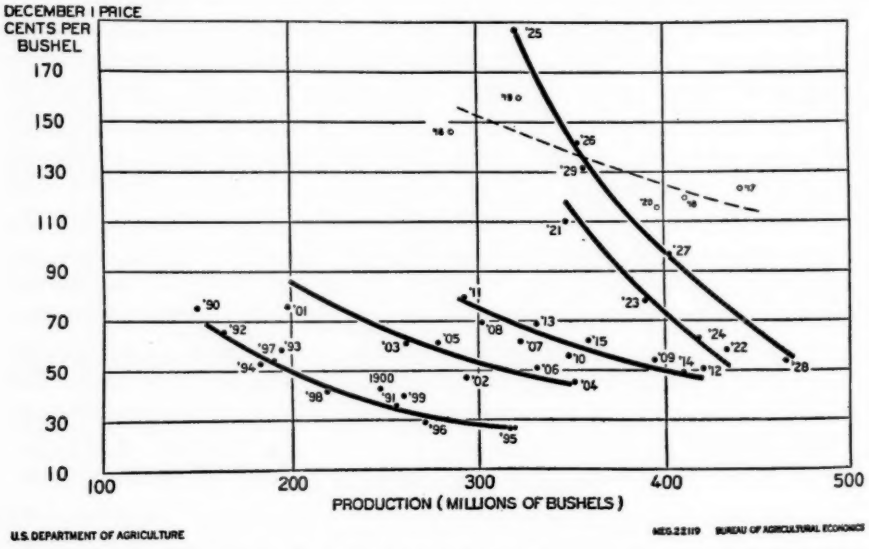


FIGURE 1.—Potatoes: Dec. 1 Farm Price and United States Production, 1890-1929.

cycles are available in the data there is more chance of arriving at an approximation of one of the longer-time normal demand curves.

It is not to be assumed, even in the case of short-time normal demand, however, that the average demand curve can first be satisfactorily approximated without reference to the shifts to which it has been subject, and that one may then proceed to measure the shifts about this average position. Rather, the determination of the nature of the demand curve and of the shifts which have taken place in it should be part and parcel of the same analysis. For example, consider the accompanying chart of the production and farm price of potatoes in the United States for the period 1890 to 1929 (Figure 1).[2] Suppose there were no curves drawn in on the chart. How would one fit an average demand curve to the data? A single curve which would most nearly fit all the data as they stand would be one with a positive slope (i.e., upward and to the right) rather than with a negative slope. Obviously, some assumption must be made as to changes in demand before one is justified in applying a negatively sloping curve. In this case, however, it is fairly obvious that there are two outstanding factors which have been primarily responsible for the changes in demand; changes in the general level of prices and a fairly gradual increase in demand in terms of deflated prices.

But even though trend be removed from the quantity data and the price data be deflated, there may still be uncertainty about the nature of the demand curve and of shifts in demand. Take the case of rice (Figure 2).[3] Here it becomes apparent that demand, in terms of deflated price, was at a high level in 1916-17, in 1917-18, and in 1919-20. But what about 1920-21? Is this an instance when the demand curve was at about the same level as in 1922-23, 1923-24 and 1928-29, or should the demand curve be shown as a more nearly straight line and 1920-21 be considered as a year of an abnormally high demand. The answer is not forthcoming unless we have information in addition to that shown on the chart and which indicates whether or not demand was at an average or a high level in 1920-21.

A more striking example of how inference as to the nature of the demand curve may be dependent upon other evidence as to

---

[2] This chart is the result of an analysis by Mr. L. H. Bean of the Bureau of Agricultural Economics.

[3] Prepared under the direction of Mr. Carlos Campbell of the Bureau of Agricultural Economics.

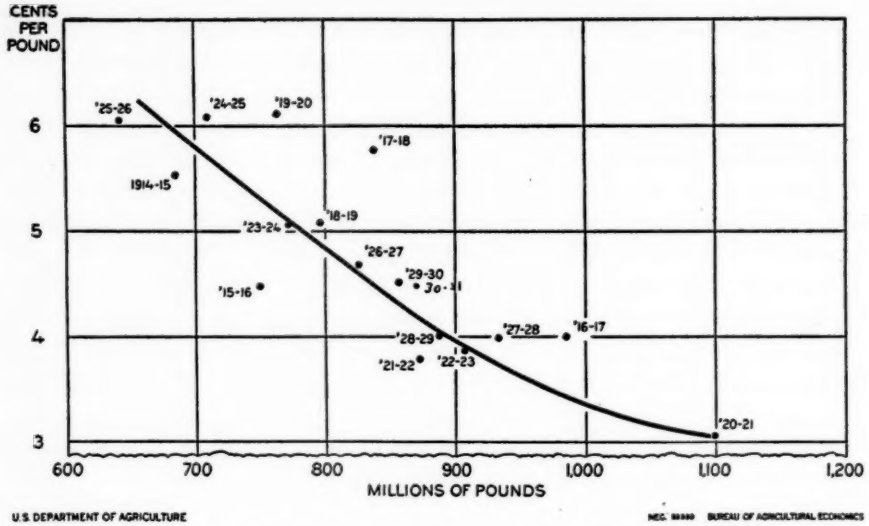


FIGURE 2.—Rice: Relationship of Deflated Price of Fancy Blue Rose at New Orleans and Sales of Southern Rice (Trend Removed) 1914-15 to 1929-30.

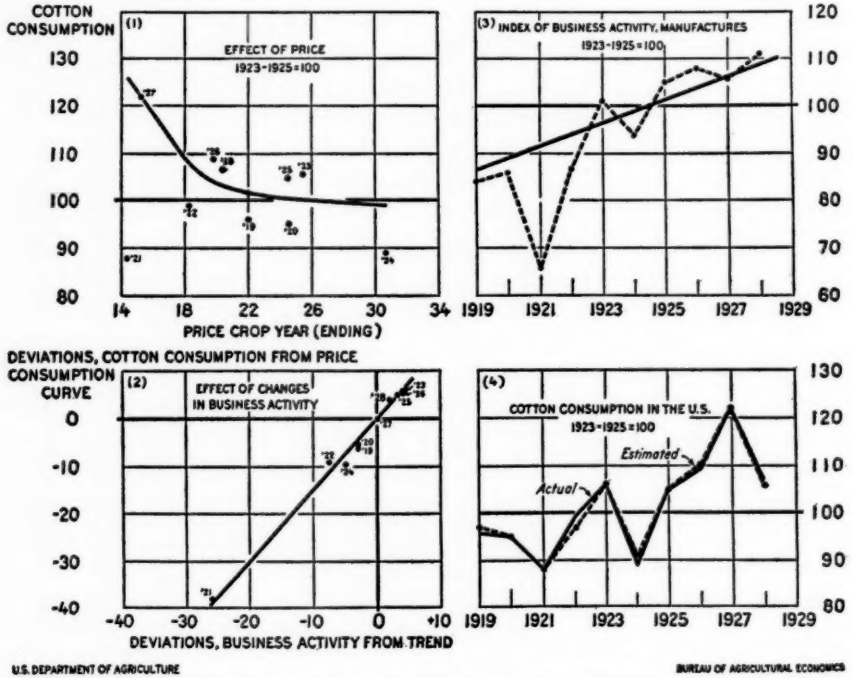


FIGURE 3.—The Effect of Cotton Prices and Business Activity on Domestic Cotton (Mill) Consumption.

shifts in demand is indicated by the relation between cotton consumption and prices since 1921 (Figures 3 and 4). The coordinates of price and consumption alone give no clue as to the nature of the demand curve. When, however, changes in business activity are considered as having an effect on the consumption of cotton, it is immediately seen that the relation between the price and consumption of cotton during this period is of the general sort that one would expect it to be. Further analysis as conducted by Mr. Bean of our Bureau yields relationships such as those shown in Section (1) and (2) of Figure 3.[4] We cannot be certain just how nearly these curves represent the true causal relationships between the consumption of cotton, the price of cotton, and the rate of business activity. Nevertheless the relationships are close enough and they are sufficiently in accord with theoretical reasonableness to justify using them as indications of the relative importance of changes in demand and changes in price in affecting the yearly rate of cotton consumption. These are shown respectively by the solid lines of Sections (1) and (2) of Figure 4.[5]

Two studies of the relation of beef and pork prices to consumption which were made by Mr. Thorne, show a similarly great

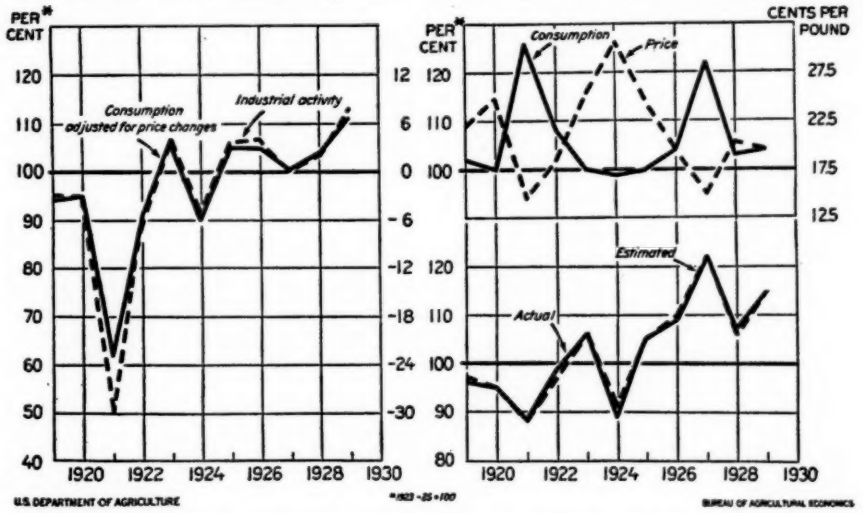


FIGURE 4.—United States Mill Consumption of Cotton Related to Cotton Prices and Industrial Activity, 1919-1929.

---

[4] Bean, L. H. "A Simplified Method of Graphic Correlation," *Journal of the American Statistical Association*, December, 1929, p. 396.

[5] Bean, L. H. "Post-War Interrelations between Agriculture and Business," *Proceedings of the International Conference of Agricultural Economists*, 1930, p. 185-186.

importance of business conditions in causing shifts in the demand curves for these products.[6] The outstanding differences between these studies of the demand for meat and Mr. Bean's study of the demand for cotton lie in the fact that they are designed to indicate the importance of factors affecting price rather than of factors affecting consumption, and in that an additional factor must be considered in order to arrive at a fairly complete explanation of the changes in demand (See Figures

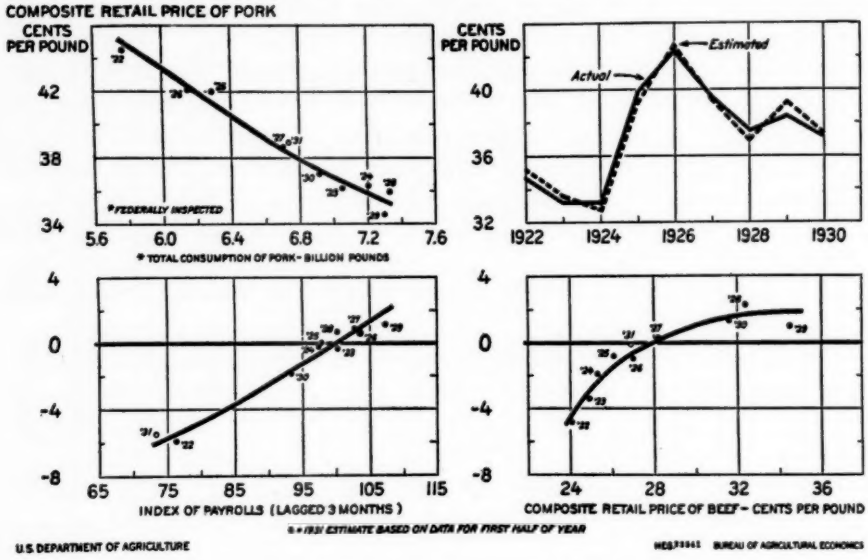


FIGURE 5.—Relation of Pork Prices to Consumption, Consumer Incomes, and Beef Prices, 1922-1930.

5 and 7). In the case of the beef price study it is necessary to take account of changes in the price of pork as a factor affecting the demand for beef, while in the pork price study it is necessary to consider the price of beef as affecting the demand for pork.

The effect of changes in demand as indicated by these analyses is shown by Figures 6 and 8. It should be noted that in both of these studies the apparent effect of changes in demand is expressed in terms of money prices rather than in terms of deflated prices.

The substantial reliability of the relationships obtained in the beef price study is indicated by the fact that studies of cattle

[6] Bean, L. H., and G. B. Thorne. "The Use of 'Trends in Residuals' in Constructing Demand Curves," *Journal of the American Statistical Association*, March, 1932, p. 64-66.

prices before, during, and since the War yield similar relationships, save for the fact that the cattle price studies require the inclusion of the price of hides as a fourth independent variable.

The few examples which I have cited are sufficient to indicate that year-to-year shifts in the demand for certain agricultural products are at times of primary importance in determining their prices. Furthermore, these, together with a large number of other studies which I have not mentioned, suggest that the

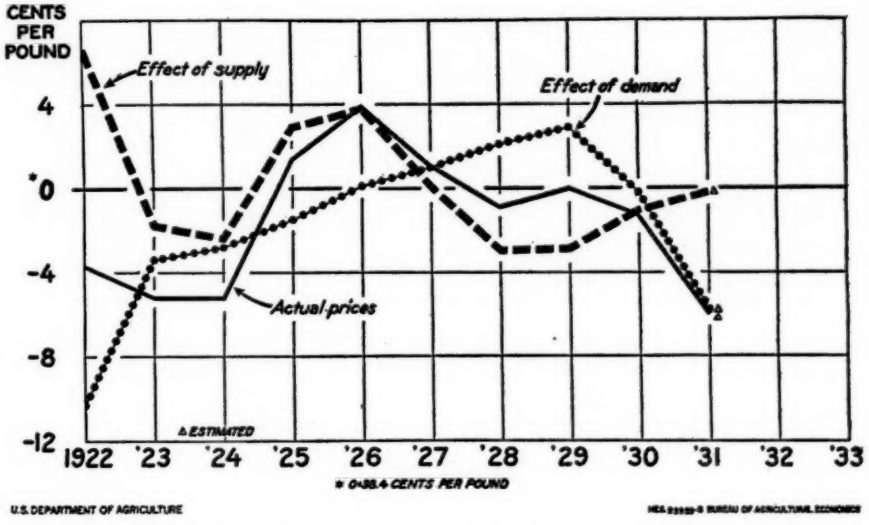


FIGURE 6.—Effects of Supply and Demand on Retail Pork Prices, 1922-1931.

state of business activity in any given year is commonly of rather general importance as a factor affecting the demand for agricultural products. There are a few agricultural commodities for which the demand, when measured in terms of a deflated price, does not appear to be much affected by the current business depression, but these are the exception rather than the rule.

In order to indicate more explicitly the effect of changes in demand on the prices of agricultural products and yet to avoid presenting the results of a large number of individual analyses I have prepared a tentative analysis of factors affecting the prices of crops, and of livestock and livestock products during the past ten years. The basic data for the analysis consist of four series of index numbers of the production and prices of crops, and of livestock and livestock products. These index numbers were prepared under the direction of Mr. Bean. As the in-

dexes themselves were completed only within the past week, you will recognize that the analysis is distinctly tentative for I have not had sufficient time fully to test out the inferences which I have thus far made or to carry through a formal statistical analysis of the entire set of data.

Turning first to the indexes of production and price of crops, we find by plotting the coordinates that there is very little gross correlation between the production and the deflated price indexes

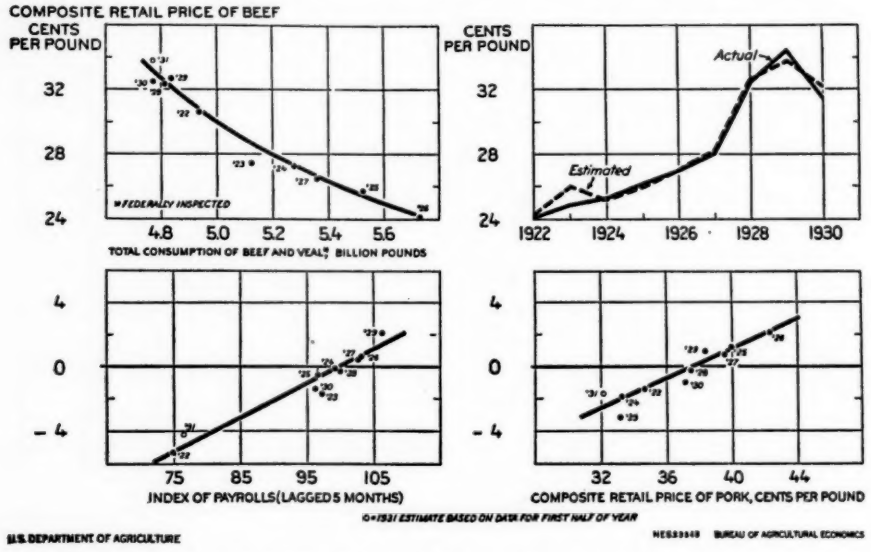


FIGURE 7.—Relation of Beef Prices to Consumption, Consumer Incomes, and Pork Prices, 1922-1930.

(Figure 9). When business conditions are taken into consideration, however, a close relation between the index of crop production and the deflated price index becomes apparent. Furthermore, the remaining deviations of the actual prices from those which would be expected on the basis of the observed relationship between crop prices, crop production and domestic business conditions is found to be closely related to the deflated value of that part of our agricultural exports which is classified as vegetable products. Hence we find it possible to explain most of the variations of the average level of crop prices in terms of (1) the volume of crop production, (2) an index of domestic business conditions, representing the fluctuations of domestic demand, and (3) the deflated value of the exports of crops, representing the fluctuations of foreign demand.

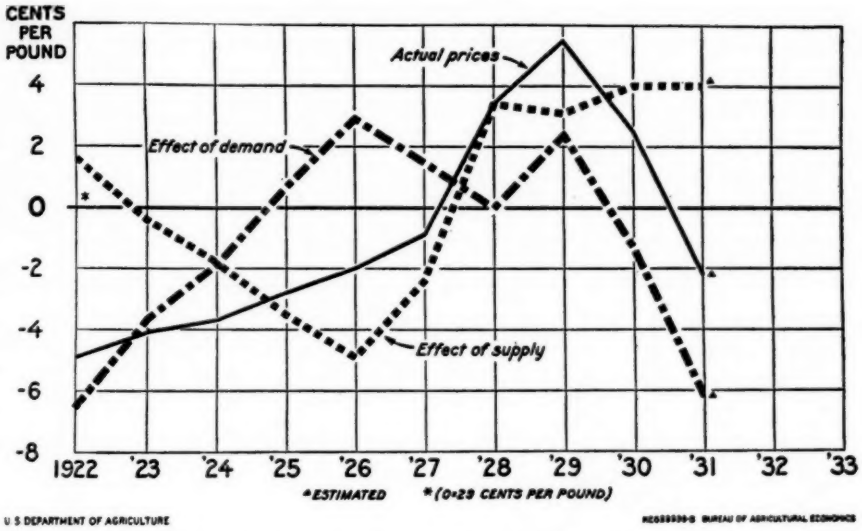


FIGURE 8.—Effects of Supply and Demand on Retail Beef Prices, 1922-1931.

Some further explanation is necessary of the justification which there may or may not be for using the total value of exports as an indication of the strength of export demand. In order to measure foreign demand accurately, the nature of the export demand curve should be determined and the shiftings of this curve measured. Some preliminary work which Mr. Bean has done on this problem has indicated that the elasticity of the export demand for agricultural products as a whole is fairly close to unity. If the elasticity of demand were unity, the deflated total value of exports would, of course, be a perfect index of shifts of the export demand curve. It will be noted that the largest deviations from the curve which shows the relation between value of exports and prices are in 1925 and 1926. Wheat and cotton are of outstanding importance in our exports of vegetable products. In 1925 the quantity of wheat exported was very small, but prices were high. In 1926 the quantity of cotton exports was extremely large but prices were very low. Hence 1925 should represent a point well up and to the left on the export demand curve while 1926 would represent a point low and to the right. Furthermore, if the elasticity of export demand is greater than unity, the use of the total value of exports would result in under-estimating the strength of export demand in 1925. Conversely the strength of export demand in 1926 would be over-estimated. It may well be, then, that the relatively wide

deviations of 1925 and 1926 are due to the deflated total value of vegetable product exports being a poor index of shifts in the export demand for crops.

Turning next to the production and prices of livestock and livestock products (Figure 10) we find that similar relationships may be worked out. Here, however, I changed the order of analysis. Because of the very unpromising appearance of the scatter diagram of prices and quantities it seemed desirable to deal first

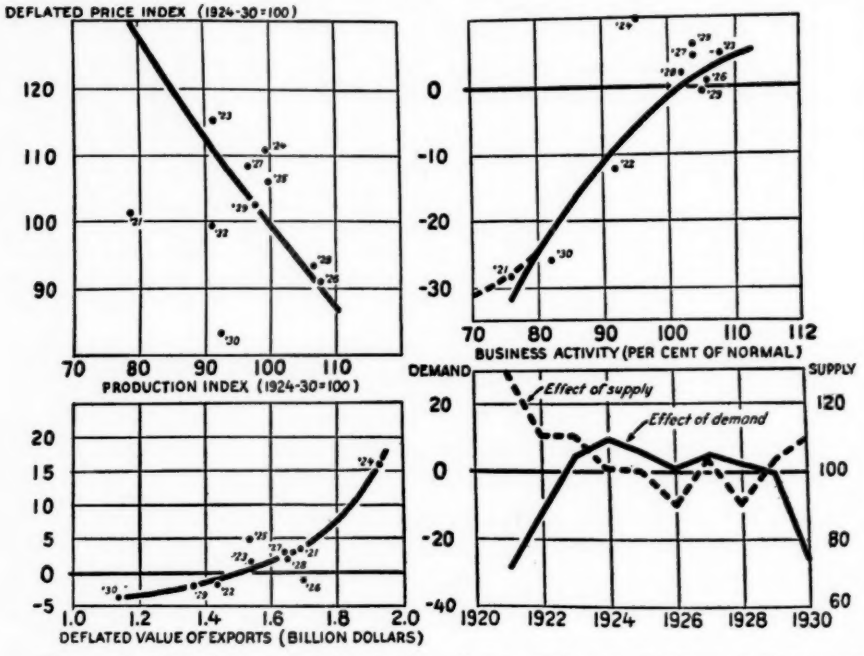


FIGURE 9.—Relation of Deflated Index of Crop Prices to Business Activity and Crop Production Index.

with the relation between business activity and prices. This was done with the final result which you see depicted on the chart.

In comparing this with the analysis of crop prices it is significant that a fairly complete explanation of price changes seems possible without taking any account of changes in export demand. The value of exports of animals and animal products in recent years has been only about 15 per cent as large as that of vegetable products despite the fact that the value of the net production of livestock and their products has been somewhat larger than that of crops. This does not necessarily mean, however, that changes in export demand are not a factor of some

significance in affecting the price of livestock and their products. It happens that the value of animal product exports are somewhat correlated with business activity in recent years and hence their influence may be reflected in the index of business activity. The analysis of prices before and during the War will presumably necessitate some account being taken of changes in export demand.

You will also note that there is evidence of an upward trend

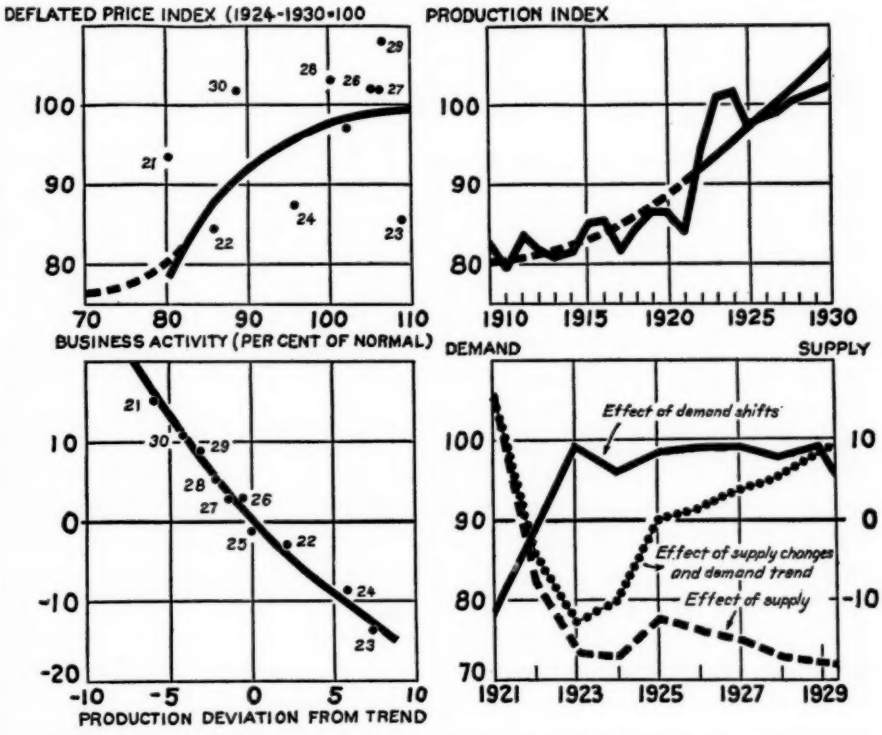


FIGURE 10.—Relation of Deflated Index of Price of Livestock and Products to Business and Production Index.

in the demand. Because of the scale to which it is drawn, the trend here shown appears to be very steep. It actually amounts in the period 1921 to 1930 to somewhat less than 2 per cent yearly. For the years prior to 1921 I have shown the production data together with a possible trend as indicated by the dotted line. This dotted portion is fitted merely from the data shown and a very general knowledge of prices and business conditions during the period. An actual analysis of the earlier data may

show that the trend of demand is quite different. The upward trend since 1921 is due quite largely, I suppose, to an increase in the per capita demand for dairy and poultry products and to the growth of population.

If the trend in demand had been measured in terms of prices instead of in terms of quantities its appearance would have been quite different. This is indicated by the fourth section of Figure 10 in which I have shown by one line the apparent effect of supply *and* the trend in demand, and by another the apparent effect of supply alone. If the difference between these two, that is the price-effect of the trend in demand, were plotted it would give a line which rises more steeply in the earlier years than in the later.

This difference in the trend of demand, depending upon whether it is measured in terms of price or of quantity raises the question of whether shifts in demand should be measured in terms of vertical, or of horizontal, or of some other sort of deviations. Ideally, the direction of measurement should be parallel to that in which the shifts take place. If the shifts of the demand curve be straight up and down, the measurements should be in terms of price deviation, if the shifts be directly to the right and left they should be measured in terms of quantity deviations. Though there is no clear evidence I suspect that most of us are inclined to the belief that the shiftings are diagonal, that is upward *and* to the right, and downward *and* to the left. If such be the case and the demand curve be significantly curved a given shift of demand has a greater effect on price at a time of small supply than at a time of large supply.

Probably the most generally satisfactory means of dealing with the problem when there is evidence of a marked curvature of the demand curve is to put the data in such form that an approximately straight line relationship is obtained. This can frequently be done by the use of logarithms of supply and price in place of natural numbers. I myself am inclined to use reciprocals of quantities, where that is feasible, and to express the factors related to the shifts of demand in terms of ratios to the particular quantities. Thus the equation of a shifting equilateral hyperbola may be expressed as:

$$xy = a + bz + - - -$$

or as:

$$y = a\frac{1}{x} + b\frac{z}{x} + - - -$$

It is not necessary that the demand curve be an equilateral hyperbola in order to use this method of attack for we may have the following:

$$y = a + \frac{b}{x} + \frac{c}{x} + \frac{z}{x} + \cdots$$

So much for the general inadequacy of measuring shifts of demand in terms of simple price or quantity deviations. Let us return to our consideration of the shifts in demand for the two general classes of agricultural products. In these two cases the error involved in measuring the shifts in terms of price deviations and the trend in terms of quantities is not very serious because of the relatively small amount of curvature in the approximation of the demand curve.

I wish to call especial attention to the relationship between price and business activity indicated on these charts. The solid curve represents the approximate nature of the relationships as far as I think they can be inferred from the data here given. However, I am inclined to think that the dotted lines at the lower end of these curves more nearly approximate the true causal relationships which exist. Would a level of business activity of 60 per cent of normal result in a level of prices for livestock and their products of around 50 or 60 per cent of their average, supplies being normal? I doubt it. Similarly I am inclined to doubt that such a level of business activity would result in as low a level of prices of crops as is indicated by the extension of the solid curve on the crops chart. Furthermore preliminary information for the current year, in which business activity has been at a lower level than for any of the previous years included in this study, indicates that the effect of the lower level of business activity has not been so drastic.

The uncertainty which attends a decision as to what should

INDEXES OF PRICES AND NET PRODUCTION OF CROPS AND LIVESTOCK IN THE UNITED STATES, 1921–1930
(1924–1930=100)

Year	Crops		Livestock	
	Production	Price	Production	Price
1921	78.7	99.7	84.1	94.5
1922	91.1	105.9	94.2	84.5
1923	91.4	119.2	100.9	89.0
1924	99.3	117.2	101.3	88.6
1925	99.9	114.4	97.1	103.7
1926	107.8	92.7	98.5	105.3
1927	96.8	110.4	99.4	100.5
1928	106.8	95.4	100.5	103.9
1929	97.2	101.6	101.2	107.4
1930	92.2	88.3	102.0	90.7

be the nature of the lower ends of these curves is not the only point of uncertainty about the analysis. In the process of analysis I first attacked crop prices. My first approximation of the relationship between business activity and prices was that of a straight line, and I was not disposed to change it until after I had studied the livestock and products prices in relation to their production and to business activity. Even yet I do not consider that there is clear evidence that the relationship should not be rectilinear. Incidentally the use of a straight line relationship for business activity would have very little effect upon the supply and price relationship. Even in the case of livestock and livestock products, the use of a linear relationship between business activity and price would indicate only a small change in the regression of price on quantity. The uncertainties involved in these two little analyses are an excellent example of the problems which always beset the economist who is using statistical analysis in the attempt to arrive at quantitative measures of cause and effect relationships. There is always the problem of whether the failure to "explain" completely a certain change in price is due to the omission of some important cause, to the use of the wrong independent variable, to the failure to determine the precise nature of one or more of the relationships, or to inaccuracy of the data. In using graphic correlation in the process of analysis there is always a question of whether in order to "take care" of a given observation one curve should be bent a little here or another there, or whether that observation should be "explained" in terms of some other variable.

These analyses also provide an excellent illustration of the very great usefulness of graphic methods of correlation.[7] One of the great advantages of a graphic method of correlation such as that used here is that it lends itself so readily to the interplay of induction and deduction in the process of arriving at inferences from statistical data. Another great advantage, to my mind, is that graphic methods help to give the investigator an appreciation of what really happens in the process of correlation. To those who have not seriously tried them I heartily recommend the use of graphic methods of correlation both as an aid in carrying on original investigations and as an aid in testing and appraising the results of others. Of course great care

[7] For a general explanation of these methods see the following: "A Simplified Method of Graphic Curvilinear Correlation" by L. H. Bean in the *Journal of the American Statistical Association*, December, 1929. Chapter 16 "Short Cut Methods of Determining Net Regression Lines and Curves" in *Methods of Correlation Analysis* by M. J. B. Ezekiel.

must be used not to place too much confidence in a limited number of observations and to bear in mind the number of variables and degrees of freedom.

I suppose that such ideas cause some of my good friends fairly to boil in disagreement and indignation. One who holds that knowledge of probable (or standard) errors, frequency distributions and such, are highly essential to any interpretation of time series correlations, will have little use for graphic methods. Certainly if one is to depend on *statistical* inference in order to draw conclusions from correlation analysis a knowledge of probable errors and frequency distributions is essential. To me however, these things are usually of minor use in time series analyses.

The difference in view point is fundamental. One view is that a given space of time constitutes a sample from a universe of some longer period of time; that by discovering the relationships between various factors in this "sample" period we can arrive at a mathematical expression of the relationships of co-variation between the several factors. Then by noting and measuring certain characteristics of the data in the sample period, some basis is afforded for judging within what limits the relationships of co-variation in some other period are likely to vary from those of the "sample" period.

The other view is that a given space of time provides a sort of moving picture of a mechanism in operation. It is a very complicated mechanism—not all of the wheels, levers, springs, cogs, pistons and other operating parts are visible. The problem is to determine how the thing operates; what visible parts are related to what other parts and how. If we can determine how the thing is put together and how it operates by observing it in one period of time, we know how it will operate in another period of time. Furthermore, if we have learned how a given mechanism operates we will have a good basis for deducing how it may be expected to operate at some other time after certain alterations have been made in it. We will likewise have some basis for judging how some similar mechanism may operate even though we have not had the opportunity to observe it in operation.

The two viewpoints, the appropriate procedure of analysis and sometimes the superficial results are as far apart as the poles. For my own part I prefer in my analyses of time series data to adopt the second viewpoint and attempt to derive the causal relationships between the data. Whenever possible, I also like

to analyse the same data and to further test my results in the light of the other viewpoint and the methods appropriate to it.

In closing I have one further observation to make. The demand curves of conventional economic theory are causal relations. If in our statistical analyses we do not approximate the causal relations between price and quantity we do not approximate the demand curves of theory.

Discussion by Wassily Leontief

National Bureau of Economic Research

In all the three exceedingly stimulating papers which have been read, a problem has been neglected that is of fundamental importance in the theoretical treatment of the issue, and consequently for the significance of the statistical results obtained.

The whole analysis is based on the distinction between the slope ("elasticity" in a logarithmic scale) of a demand (or supply) curve and its level—(some authors call it the "intensity" of demand). The goal of the presented statistical studies is the measurement of shifts, i.e., changes of the level of curves.

The procedure consists in projecting the shifting demand curve on the "price-quantity" plane (see figure in Professor Schultz's paper) and measuring the distances between its different positions. If the shifts of this curve are parallel (the elasticity unvaried) this measurement does not present any difficulty. Even if we alter the direction in which we measure the distances between the different positions of the curve, there is a change only in the general scale in which the shifts are presented without varying their relative sizes. But if the demand curve has changed its slope, then the measurement of the shift becomes a real problem. The difficulty is most apparent in the case when the two successive positions of the curve lines cross each other: the one will appear to be higher than the other if the measurement is made at one side of the crosspoint, and lower if the distance is measured on the other side.

I think that it is possible to give a theoretically and practically consistent solution of this problem, but the presentation of it now would lead us too far.

Of course one can, and Professor Schultz does, use a mathematical formula in the statistical calculation of demand curves, which does not allow any changes in the slope. This means that he obtains *one* slope which represents an average of the many different unknown "real" slopes of the demand curve in different points of time. So far as the slope alone is concerned, it is quite satisfactory, but when these average parallel curves are used for the measurement of shifts, the procedure becomes dubious. The distances between these "average" parallel curves as measured by Prof. Schultz combine two elements: (a) the "real" shifts of demand, and (b) the deviation of the "real" slopes of the curve at the different points of time from the average slope, which is statistically derived from the whole period of time. Consequently the shifts derived by using a constant ("average") slope ("elasticity") do not represent the theoretically defined shifts of demand, but include elements of change in the slope of the curve.

INTERNATIONAL RELATIONS AND FINANCIAL CONDITIONS IN FOREIGN COUNTRIES AFFECTING THE DEMAND FOR AMERICAN AGRICULTURAL PRODUCTS[1]

LEO PASVOLSKY
THE BROOKINGS INSTITUTION

The factors which affect the foreign demand for American agricultural products are diverse and complex. The conditions of physical production in the principal producing areas of the world, the relation between output and consumption, and the movements of prices of agricultural products are, of course, among basic considerations. On these aspects of the problem, however, I shall touch only incidentally. All of you, I am sure, know more about them than I do. But there are other aspects of the problem which are of utmost importance, since they determine the general structure of international commercial relations and consequently of our foreign trade in agricultural products. I am referring particularly to such questions as general financial and currency stability and the whole broad problem of national purchasing power. It is to a presentation of these factors that I shall apply myself in this paper, not in the form of a forecast of immediate trends, but rather as the setting forth of the basic principles involved, illustrated by the experience of some of our principal markets.

Whatever the course of development that American agriculture may follow in the future from the point of view of possible shifts in the character of production, I think it is a safe assumption that its productive machinery is geared to turn out an excess above domestic consumption, even under conditions of prosperity. For the future that we can now visualize concretely, America will continue to seek foreign markets. And our ability to dispose of such agricultural surpluses will obviously depend on the ability and the willingness of our foreign markets to absorb them. "Ability" refers, of course, to the purchasing power at the command of the importing countries, and "willingness," to the commercial and economic policy pursued by them.

A country's purchasing power relates to its international balance of payments, that is, the size of its international income available for foreign purchases. But a mere statistical examination of a country's position in this respect would be far from

[1] Paper read at the Twenty-second annual meeting of the American Farm Economic Association, Washington, D.C., December 28, 1931.

sufficient for our purposes, since that position is subject to rather wide fluctuations, resulting from the action of a variety of factors. A country's commercial and economic policy is one of these factors, and at times a rather important one. A country's ability to import and its willingness to do so are, therefore, more or less interconnected, with the former more likely to influence the latter, generally speaking, than the other way round.

It would be carrying coal to Newcastle for me to discuss before you in any detail the evolution and the geographical distribution of our agricultural export trade. I shall confine myself in this respect to a mere review of some of the salient features of this subject in order to place in a perspective needed for the purposes of this paper the data which are immediately pertinent to the discussion.

Great Britain is the largest single market for American agricultural exports. She occupied this position before the War, and she has held it since the War, although her relative share in our export trade is not as large today as it was two decades ago. Nevertheless—to mention only our principal agricultural exports —she still heads the list of our customers of tobacco, lard, and wheat. Of the first two of these commodities, she has been taking since the War much larger quantities than before the War. In wheat, we have been in the last few years just about holding our own as compared with the pre-war figures. In cotton Great Britain's post-war imports are decidedly below what they have been before the War, and she has been alternating with Germany at the head of the list.

Generally speaking, wheat, lard, and tobacco belong to the category of a large variety of products which Great Britain brings in from abroad for domestic consumption. Cotton, on the other hand, is one of a number of commodities which she imports partly for domestic consumption, but more largely for the purpose of processing the raw materials and exporting them in the form of finished or semi-manufactured goods. The volume of her imports of commodities intended for domestic consumption will be governed by the size of her international income, from whatever source it may be derived. On the other hand, the volume of her imports of such raw materials as cotton will clearly be in a more or less definite relationship with her own exports of cotton manufactures.

An examination of Great Britain's international trade and service operation during the last two decades reveals a number

of extremely interesting facts. If we compare her commodity trade position in the years 1913 and 1929 (both of them somewhat better than the average years for the periods in question), we find an increase in the total of both the exports and the imports, with the latter, however, showing a much larger expansion than the former: the exports in 1929 exceeded those in 1913 by about a billion dollars, while the imports were larger by 2.2 billions, with the result that the excess of imports over exports was in 1929 more than twice as large as in 1913. Even allowing for changes in the price level, these figures clearly indicate a substantial relative increase in imports, primarily in the volume of commodities brought in mainly for domestic consumption.

Great Britain has been able to cover these increased trade deficits by means of an expanding income from international service operations, such as shipping, insurance, banking, etc., and the returns from her foreign investments. In fact, the income from these sources was, until 1931, sufficient not only to cover the trade deficits, but also to leave annually a certain amount of funds available for new foreign investments. As a result of this, Great Britain has continued since the war to be a capital exporting country.

However, Great Britain's post-war exports of capital have habitually exceeded the net balances in her international trade and service operations. For example, during the five years 1926-30, the new foreign issues offered publicly in the London market exceeded the aggregate net balance for those years by something like 800 million dollars. To these should be added other forms of long-term investments, as well as the large short-term credits extended by Great Britain to other countries. These items of outgo were in turn covered by Great Britain's own foreign borrowing on long and short-term account.

In the light of what has happened to Great Britain in the last few months, it is decidedly open to question whether or not she was wise in permitting her economic life to develop in the manner outlined above. During the current year, the accumulating effects of the profound economic depression which has overtaken the world have become expressed in a sharp contraction of revenue from service operations, making it increasingly difficult for Great Britain not only to continue making new foreign investments, but even to pay for her imports. This, in conjunction with such factors as the state of public finances, the domestic political situation, etc., weakened the country's foreign exchange

position to a point at which waning confidence on the part of her foreign short-term creditors led to large withdrawals of funds, which finally forced Great Britain off the gold standard and placed before her new and difficult problems of future adjustment, which are likely to have a profound effect on her whole international trade position.

As matters stand today, Great Britain appears to be acting on the assumption that she cannot, in present circumstances, afford the luxury of as large imports of consumption goods as she has had since the war. Her newly introduced protective tariff is bound to affect her purchases of at least some agricultural products. To the extent to which such a tariff might raise her costs of production, it will not make her international competitive position any easier than it has been heretofore. The palliative of currency devaluation, to which some people in Great Britain attach much importance, is not likely to be more than temporary in its effects. On the other hand, such currency devaluation is likely to have still further adverse effects on the country's income from service operations and thus render the maintenance of a large excess of imports over exports more difficult.

Finally, if the introduction of a protective tariff in Great Britain should prove a precursor of some sort of a preferential arrangement between the mother country and the Dominions, such a régime is bound to have important effects on the British imports from other sources, of commodities which the Dominions are able and ready to supply. This is especially true of wheat.

So much for the imports of goods destined for domestic consumption. As regards raw materials—in this case specifically cotton—Great Britain's purchases depend upon her ability to develop markets for manufactures made out of these raw materials. Great Britain has so far failed signally in regaining her textile markets lost during the war. What the future holds in store for her in this respect no one can tell.

Germany, our second largest customer for agricultural products, is confronted, in her international financial position, with even more difficult problems than those which Great Britain is compelled to face. Like the latter, she also imports substantial quantities of agricultural commodities intended for domestic consumption, as well as large amounts of American cotton for the purpose of processing it and exporting a large portion of the product. However, while the volume of her cotton imports is today much nearer the pre-war figure than is the case with

Great Britain, her imports of wheat and tobacco are smaller than they were before the war. Of the four commodities we mentioned in connection with Great Britain, only of lard does Germany now import larger quantities than before 1914. Like Great Britain, Germany has had habitually in her commodity trade an excess of imports over exports. How does she pay for these imports?

The German situation since the war has been dominated to a large degree by the reparation question. The efforts made by Germany during the early post-war years to meet the reparation demands of the Allies, superimposed upon the general disorganization of the country caused by the war and its basic weakening as a result of the treaty of peace, brought about, in 1923, a complete economic and financial collapse of Germany. She emerged from this period of chaos into one of reorganization and reconstruction, during which she met regularly substantial reparation payments under the Dawes and the Young plans. For six years, 1925-30, Germany was able to meet her debt payments and to maintain a substantial excess of imports over exports with only a negligible income from international service operations. She did this by means of immense foreign borrowing.

This process was bound to come to an end sooner or later. Because of the fact that a large part of what Germany borrowed she obtained in the form of short-term credits, the end of the process was bound to be rather disastrous. And it was fully as disastrous as might have been anticipated, when it finally came last summer.

Germany is saddled today not only with her reparation obligations, but also with a huge foreign debt accumulated during the last few years. She can discharge her obligations only by developing an export surplus of adequate dimensions. During the last two years she has had an export surplus, still insufficient to enable her to meet more than a part of her obligations, but nevertheless, especially during the last few months, a substantial one. However, this change in her foreign trade position from an excess of imports to an export surplus was accomplished by means of a drastic reduction of her imports relatively to her exports, a reduction involving basic raw materials, as well as consumption goods. Such a condition cannot continue long in a country whose exports consist to an overwhelming degree of manufactured goods into the production of which imported raw materials enter in a substantial measure.

Whatever the size of the reparation payments which Ger-

many will have to make, the meeting of these obligations and of the charges on her huge nonreparation debt imperatively requires a development by Germany of an export surplus, which can scarcely be achieved without a permanent substantial reduction of imports. Since raw materials are indispensable for her own exports, the major portion of reduction in the German imports is likely to come on the side of goods for domestic consumption, probably foodstuffs as well as others. It is rather worthy of attention that in the German proposal presented to the Young Committee in 1929, the following was stated categorically as one of the conditions prerequisite to the fulfilment by Germany of any program of reparation payments: "As far as the German food supply is concerned, it is most essential that her imports of foodstuffs should be reduced and partly replaced by an increasing home production."

Germany has been definitely moving in this direction. By means of protective tariffs and milling regulations she has been attempting to reduce her imports of foreign foodstuffs, while by means of these same measures, with the addition of subsidies of various kinds, she has been striving to expand food production within the country.

But it is not sufficient for Germany merely to reduce her imports. She must also expand her exports if she is to be able to discharge her obligations, and at the same time maintain her national economic activity on what might be considered an adequate level. One of the methods of doing this that has been often proposed in recent years is the establishment of some sort of a preferential system to include Germany and some of the agricultural countries of Europe. Under any such arrangement, Germany would have to extend to these countries facilities for expanding their exports of agricultural products, especially foodstuffs, in exchange for obtaining from them added facilities for her exports of manufactured goods. Since the textile industry is one of Germany's important exporting industries, any such arrangement might increase her demand for cotton, though it might easily decrease her demand for foodstuffs from countries outside the preferential system area.

Italy, another important European purchaser of American agricultural exports, has also built up an exporting textile industry, for which she imports substantial quantities of American cotton and for the output of which she must seek markets, mainly among her European neighbors. The power of such mar-

kets to absorb Italy's own exports will depend upon their ability to dispose of their agricultural surplus, to some extent to Italy herself. On the other hand, Italy, like Germany, has been striving to make herself less dependent upon foreign foodstuffs. With her, too, the balance of payments has played a part of real importance. Italy has a large foreign indebtedness on which she has to make substantial annual payments. She, too, needs an excess of exports over imports. And in the last few years, she has undertaken a program of systematic expansion of her wheat production mainly for the purpose of reducing her imports of that cereal and thus improving the relation between her international income and outgo.

American agricultural products go to a large number of other European countries. In most of them we observe in operation pretty much the same forces as those described above. The exigencies of the balances of payments, and a whole complex of economic policies growing out of them and out of many other national and international problems, intertwine into a complex pattern of factors which affect or are likely to affect foreign demand for American agricultural products.

It is outside the scope of this brief survey to do more than refer to such far-reaching problems as the efforts made by a number of European countries now importing foodstuffs to make themselves self-sufficient from the point of view of their national food supply. Enough has been said, however, in the discussion of Germany and Italy, to indicate what an important role the balances of payments play in this process.

There is one element in the European balances of payments that is worth discussing in this connection. It is the vast body of international indebtedness that has grown up during and since the World War. We have already mentioned the reparation obligations and their importance for the economic life of Germany. Paralleling these debts, there is another group of intergovernmental obligations growing out of the War—the debts of the former allies to each other, and the debts of fifteen European nations to the United States. Large annual payments have been made on all these debts during the last few years. But it is no exaggeration to say that not one penny of these obligations has so far been actually discharged. Directly or indirectly all these payments have been made out of new borrowing, with the funds provided primarily by the United States. Moreover, new international loans have been contracted for other purposes than the

meeting of current debt obligations. The result of all this has been that the countries of more than one-half of the continent of Europe are confronted today with an imperative need for arranging their economic affairs in such a manner as to develop in their international financial relations an excess of exports over imports. Of these countries, Germany is the most glaring example.

This piling up of international debts has been an extremely important factor in creating a condition of affairs in which the very basis of economic activity—a stable and sound currency—is seriously threatened. The currency debacles of the last few months are once more giving us a taste of that general uncertainty and disorganization from which orderly economic activity suffered so acutely during the years of monetary demoralization immediately following the War.

These conditions prevail not in Europe alone. They exist elsewhere in the world; in South America, in the Far East. Here, too, they are factors that are of consequence to American agriculture.

In recent years, important markets for American agricultural products have developed outside of Europe. In fact, if we look at the recent evolution of American foreign trade in agricultural products, we find in it one rather striking feature: a much wider geographical distribution of sales than before the War. Take cotton, for example. During the last five-year period preceding the World War, Europe took, on the average, 94 per cent of our cotton exports. During the five years preceding the present depression (1925-1929), with the total volume of our cotton exports averaging annually almost exactly the same amount as during the pre-war five-year period, Europe's share in our cotton exports was only 79 per cent. Japan has since the War become a large purchaser of our cotton, having supplanted the great industrial nations of Europe as the purveyor of cotton goods to the countries of the Far East. With regard to tobacco, Great Britain is the only one of our important European customers that buys more American tobacco than before the War. On the other hand, China, from an almost negligible factor in our tobacco trade, has moved to the second place in the list of foreign purchasers of our tobacco, importing in recent years more than France, Germany, and the Netherlands put together. So also in wheat, the post-war increase in our exports is accounted for by the expansion of our wheat trade with the Orient, with South and Central

America, and other non-European areas fully as much as with Europe.

All this leads to the conclusion that the interests of American agriculture from the point of view of its foreign trade are today much more far-flung than they were before the War. More cross-currents of world affairs than ever before touch it now and affect its vital problems. A political or currency crisis in the Far East, for example, is of much greater significance to American agriculture today than it would have been two decades ago, although it goes without saying that, in spite of the changes that have taken place in recent years, what happens in Europe is still a matter of primary importance to it.

American agricultural exports are a part of the vast stream of international trade. The great complexity of factors which affect trade movements in general inevitably exercise their influence upon the setting in which our sales to foreigners take place. Debts, currencies, tariffs, national economic policies in general, and a host of other factors—political, economic, and social—operating all over the world, are inextricably bound together in conditioning the foreign demand for American agricultural products.

Discussion by G. C. Haas

Federal Farm Board

Although I am in entire agreement with the basic analysis presented by Mr. Pasvolsky, I wish to emphasize briefly certain additional aspects of the effects of existing financial conditions in foreign countries on the demand for American farm products, and to suggest some of the conclusions which may be tentatively drawn from the existing situation as to the trend of our agricultural exports at least for the immediate future.

Financial conditions abroad have affected the foreign demand for American agricultural products by increasing the direct competition from foreign agricultural products, as well as by restricting the importing power of foreign countries. Russian wheat shipments during the last two years have resulted directly from the financial exigencies involved in execution of the Five-Year Plan. Departure from the gold standard in exporting countries has led to temporary "exchange dumping" in international markets, notably of wheat and wool from South America and Australia. Moreover, a permanent advantage, tending to stimulate exports, can be retained by these countries in the form of a reduction in fixed costs, if their currencies are stabilized at a level below previous gold parities. Depreciation in the gold value of sterling has considerably reduced the burden of the external indebtedness of various countries, including India, Australia, Canada and many of the South American republics. As a consequence of these factors, important foreign exporters of agricultural commodities have been enabled to increase their shipments and to undercut United States exports. Importers have tended to shift their purchases to the products of countries

with depreciating currencies. The competitive position of the United States has been definitely weakened by these developments in such export markets as there are.

Secondly, the weak fiscal position of many European countries has recently led to enormous increases in taxes and reductions in social expenditures for unemployment relief. These developments along with wage-rate reductions have resulted in an extremely low level of consumption which would have effectively destroyed the foreign market for many American agricultural products even in cases in which the balance of international payments did not require rigid restriction of imports.

By far the most important effect, however, of foreign financial and political developments on the demand for American agricultural products has been their indirect influence on the domestic market, which is of major significance to our agricultural producers. Recognition of the financial instability of foreign countries caused a severe shock to business confidence in this country last year. The financial crisis, initiated by European developments, accentuated the drastic decline in industrial activity already under way in the United States, and became the dominating feature both in the agricultural and in the business depression. Manufacturing enterprises in the United States faced the necessity of adjustments to reduced markets at home and abroad, and the resulting decline in factory payrolls cut the domestic demand for agricultural products, especially cotton, livestock and livestock products, which account for a large proportion of our agricultural income.

A tentative forecast of the immediate trend of our agricultural exports may be based upon the analysis presented by Mr. Pasvolsky. He has pointed out that many countries are faced with the necessity of restoring equilibrium in their international payments by improvement of their merchandise trade balance. If the enormous existing volume of international indebtedness is to be slowly liquidated over a long period of years, most foreign countries will be forced to restrict their imports for consumption to a minimum and to increase their exports by every possible expedient during a corresponding period. This means that foreign political and financial developments must be expected to continue to exert an adverse influence on the foreign demand for many of our agricultural products, except in so far as international debt obligations are reduced promptly or indefinitely postponed by default, repudiation, or creditors' agreements. The agricultural adjustments in this country necessary to meet this situation will vary with the type of product and the peculiar conditions surrounding its market. Cotton, for example, an industrial raw material, is in an essentially different position from that of food products. Aside from the question of the ultimate wisdom of adjustment of American agricultural production as a whole toward a domestic basis, the financial position of the countries of the world today will force some adjustment in this direction over the next few years.

EUROPEAN COMPETITION IN AGRICULTURAL PRODUCTION, WITH SPECIAL REFERENCE TO RUSSIA[1]

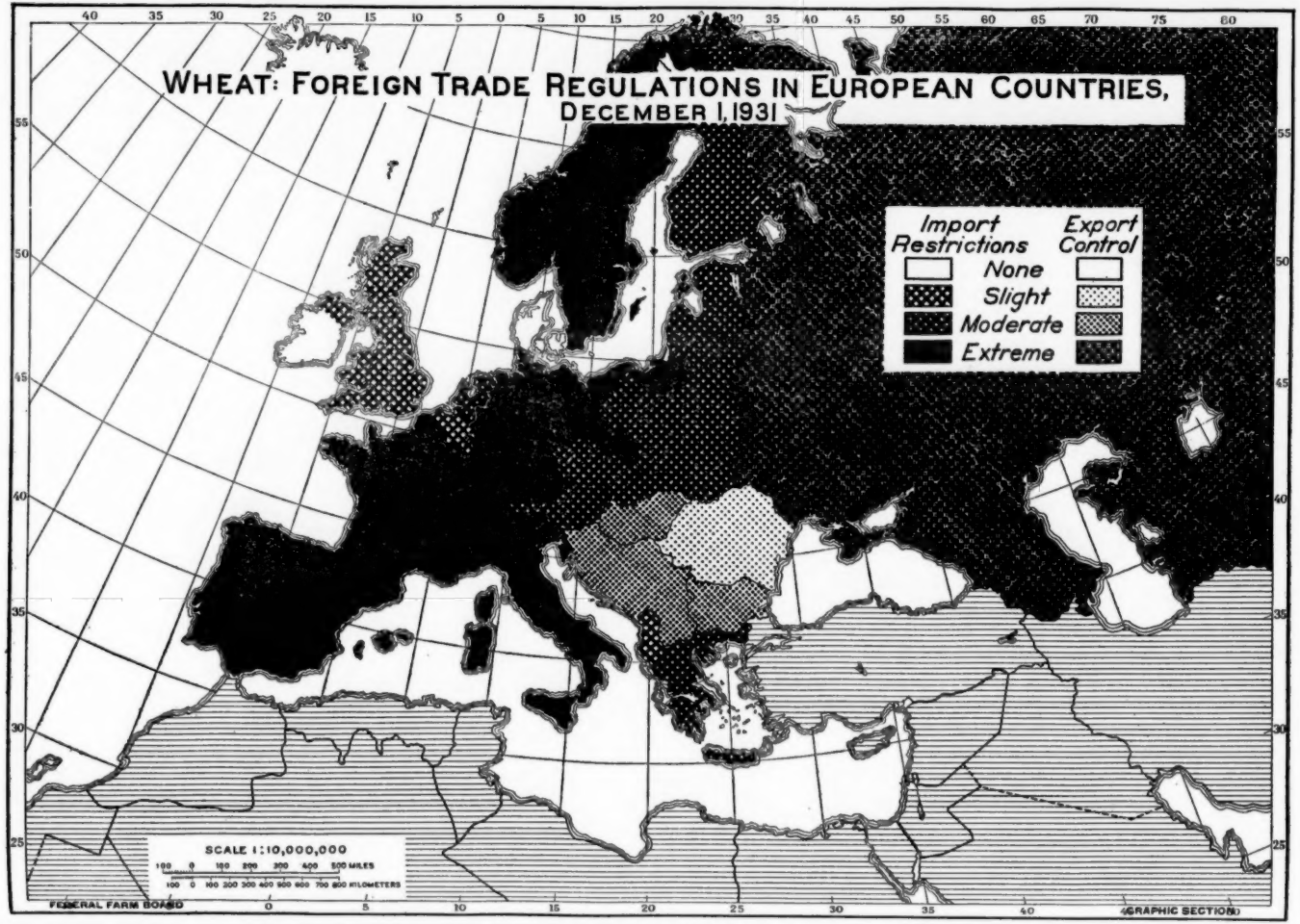
MORDECAI EZEKIEL
FEDERAL FARM BOARD

"Competition" involves all factors affecting the sale of a product. The quantity of our products which we can sell abroad is affected by production in the countries to which we sell, and by production in other exporting countries. Sales are further influenced by the ability and the willingness of our customers to buy; that is, by demand factors. Finally, our sales are affected by the extent to which we have access to the markets which do exist. Marketing methods which result in holding for too high a price, or political interferences, which impede the movement of the commodity across national frontiers, all may be reflected in the market situation at any time.

The international markets of today are characterized by the almost universal presence of political restrictions. In the past, changes in prices were dominant in controlling production and consumption, and in tending to bring them to a balance. Now, international restrictions are so numerous that the ability of prices to control economic activity is seriously weakened.

Political restrictions on international trade have taken many forms besides the long-familiar protective tariffs. The quota system for imports, by which the quantity of each product imported is definitely limited, is one new development in the way of direct control. This system is now applied by France to a wide range of products. The quota system for processors is another. As applied to wheat in many countries, this requires a definite proportion of each miller's grindings to be of domestic wheat. International cartels, for a large number of products, have divided up trade territories between them, and so have applied a very definite control of exports. In many countries today, particularly in central and eastern Europe, foreign exchange transactions are under direct control. This is apparently being used to control imports, deliberately in some countries, perhaps unintentionally in others. Purchase, sale, and import or export under government license or government monopoly, are also found in several countries. Export or production bounties also are in use. Soviet

[1] Paper read at the Twenty-second annual meeting of the American Farm Economic Association, Washington, D.C., December 28, 1931.


WHEAT: FOREIGN TRADE REGULATIONS IN EUROPEAN COUNTRIES,
DECEMBER 1, 1931
Import Restrictions
None
Slight
Moderate
Extreme
Export Control
None
Slight
Moderate
Extreme
SCALE 1:10,000,000
100 0 100 200 300 400 500 MILES
100 0 100 200 300 400 500 600 700 800 KILOMETERS
FEDERAL FARM BOARD
GRAPHIC SECTION

Russia's complete control of imports and exports is but the most extreme case of a development which is now in evidence almost throughout the world.

Economic nationalism has become increasingly important during the past decade. In part it is a further development of prewar tendencies. The peace treaties increased the number of na-

TABLE 1.—MEASURES TENDING TO RESTRICT WHEAT IMPORTS IN EUROPEAN COUNTRIES, DECEMBER 1, 1931

Country	Tariff (In cents per bushel)	Minimum percentage of domestic wheat in milling	Other measures
Albania	15.8		
Austria	55.1[a]		
Belgium	Free	15[b]	
Czechoslovakia	44.4[a]		Import license system. Fee 1 per cent.
Denmark	Free		
Esthonia	80.3	[c]	Government purchasing. Importation (permitted) from Russia and Lithuania only.
Finland	85.0		
France	85.4	97	Import license system.
Germany	162.0	97 (70)[d]	
Great Britain	Free	15	
Greece	55.2	15[i]	Government regulation of price.
Irish Free State	Free		
Italy	108.0	95	
Latvia	37.0	66⅔	Government purchasing. Gov. regulation of price.
Lithuania			Government purchasing.
Luxemburg		10	
Netherlands	Free[e]	22½	Government regulation of price.
Norway	Free		Government purchasing.
Poland	76.3		Export bounty of 18.3 cents per bushel.
Portugal	—[f]		Import license system.
Spain	74.0[g]		
Sweden	27.0	60	Government regulation of price.
Switzerland	3.0[h]		Government purchasing and price fixing.

Source: U. S. Dept. of Commerce. Tariff Division; U. S. Dept. of Agriculture, Foreign Agricultural Service; U. S. Tariff Commission.

[a] Plus turnover tax of 3 cents per bushel.

[b] Informal agreement with millers to use 15 per cent domestic wheat and to maintain a fixed price of $27 per ton for domestic wheat. (N. Y. Times, Aug. 7, 1931).

[c] Millers agreed to purchase entire domestic crop at fixed prices.

[d] Additional 27 per cent foreign wheat allowed imported and milled on proof of equal export of domestic wheat before Dec. 31. Tariff on such imports 13 cents per bushel.

[e] Except for wheat in packages weighing 2.65 pounds or less on which the duty is 8 per cent ad valorum.

[f] Tariff and amount to be imported fixed periodically.

[g] Imports prohibited until price of wheat in domestic market averages $1.59 for a month.

[h] Imports by other than registered dealers subject to surtax of $1.05 per bushel.

[i] Proposed rate

tional boundaries. In many cases the new boundaries cut right through highly developed economic areas, intensifying the restrictive effects of existing tariffs. In addition, the war stimulated nationalistic feelings, while the memory of war privations led to a definite attempt to achieve economic self-sufficiency. The example of the United States' economic success may have led small countries to imitate our high tariff policy.

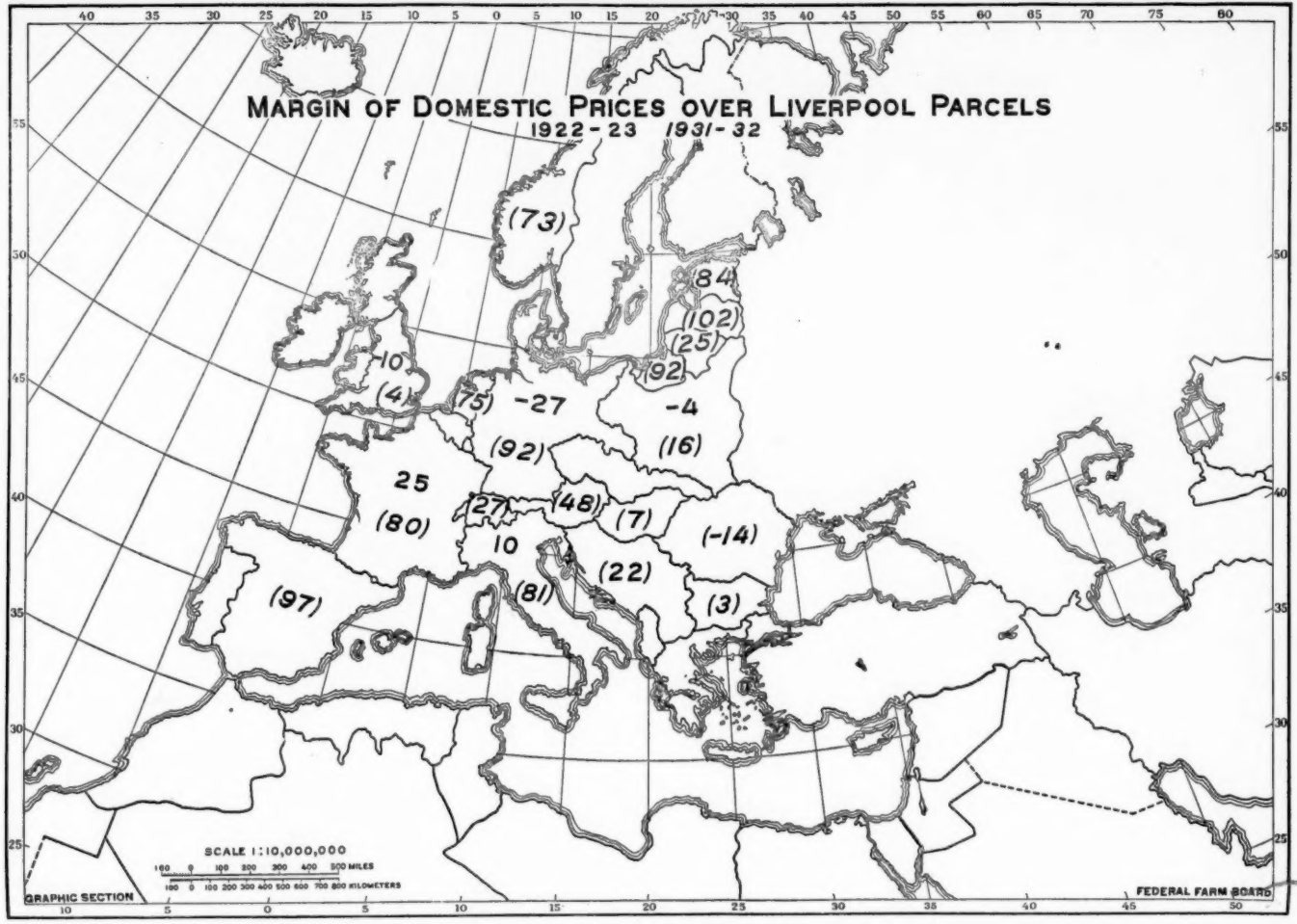


FIGURE 2.—Margin of Domestic Prices over Liverpool Parcels.

The sharp price declines of the past two years intensified protectionist measures. In the effort to protect their producers from the price debacle, many countries turned to whatever was handiest, and tariffs were advanced still more drastically. In some cases this movement was strengthened by a definite wish to protect and maintain the peasant farmers, so as to have a solid backbone of individual petty proprietors as a bulwark against communism. Most recently, the wide-spread abandonment of the gold standard has raised further price walls against imports.

Wheat is an extreme example of the extent to which political controls now interfere with free competition. During the war, production fell sharply in Europe and expanded elsewhere. After the war, Europe gradually restored her wheat acreage and production; while the upward trend in acreages continued in the over-seas exporting countries. The European producer has generally been shielded from the price declines which this overproduction brought about.

The present restrictions on wheat[2] in importing countries vary from the simple fixing of a required minimum proportion of domestic wheat in milling—10 per cent in Luxemburg and 15 per cent (proposed) in Great Britain—to tariffs, licensing of importers and millers, outright price fixing, or even complete government monopoly of the wheat trade. Many countries have elaborate and complex mixtures of these devices. In France, for example, there is a tariff of 85 cents a bushel, a domestic milling requirement (now 97 per cent), and a license system to prevent "bootlegging" of imported wheat.[3]

European exporting countries likewise have moved to help their wheat producers. Poland and Roumania pay export bounties of 18 and 16 cents respectively. Hungary has a bounty on exports, a portion of which goes back to the producer as a bounty on production. Yugoslavia and Bulgaria have government monopolies which try to maintain prices to producers and domestic consumers, while exporting at a loss. Russia, as is well known, has taken over wheat from producing organizations and sold it on world markets almost without reference to internal needs or prices.

The extent of these restrictions is shown on the accompanying map of Europe. The areas where there are no restrictions are left white. To help you find them I will point them out—Den-

FIGURE 2.—Margin of Domestic Prices over Liverpool Parcels.

[2] Michelina Michelson of the economic staff of the Farm Board is responsible for the preparation of these facts on wheat. I am indebted to her for her assistance.

[3] The attached table gives the restrictions in effect in European countries, in December, 1931.

mark and the Irish Free State. The shading indicates the degree of regulation; light shading, mild restriction; cross-hatched, medium; solid shading, extreme regulation. Solid color predominates; there is very little "*laissez faire*" in the European wheat situation of today.

The importance of these regulations may be judged from their effect on price and on production. The second map shows the price of domestic wheat in several selected countries, as compared with the price of imported wheat at Liverpool. The figure not in parentheses is the price before the extreme restrictions began; in most cases, for the 1922-23 crop. The greatest departures were 27 cents below, in Germany, and 25 cents above, in France. The figure in parentheses in each country is the price under recent restrictions, either for the past crop year or at the beginning of the present one. In England, domestic wheat was at practically the same level as imported wheat; in other importing countries domestic prices ranged from 16 cents above Liverpool, in Poland, to $1.02 above in Latvia. The price in most countries was 70 cents to $1.00 above Liverpool. In the Danubian exporting countries, the effect on prices was not so great. Hungary, Jugoslavia, and Bulgaria succeeded in maintaining domestic prices 3 to 22 cents above Liverpool; in Roumania, the limited export bounty was not enough to hold their prices above Liverpool. As a group, the importing countries of continental Europe have managed to shield their wheat producers from most of the price decline of the past two years; in the exporting countries, government action has been less effective in lessening the shock.

When prices are not free to reflect production, over-production will not be corrected. In 1924, wheat acreages in European importing countries declined slightly, following three years of declining prices. In 1930 prices on free markets dropped to one-third below those of 1924. Wheat acreages in importing countries continued to increase in 1931, reaching the highest figure since the war, and 5 per cent above those of 1929. In the Danubian countries, where prices had not been so well maintained, only a slight decline in acreage took place in 1931.

With most of Europe screened from the effect of wheat prices either on production or on consumption, almost the entire burden of readjustment is thrown on the overseas exporters. Even they are doing their best to stave off the evil day, with flat bounties on wheat production in Canada and Australia, 5 cents and 9 cents per bushel (at par), respectively. There was reduction in wheat

acreages in some overseas countries in 1931, but it was slight compared with the vast supplies accumulated.

The demand for wheat is inelastic enough at the best. When one realizes how much the world market has been cut off from the usual price reactions, it is easier to understand how prices could have been forced to such extraordinarily low levels before even the first signs of correction began to appear.

The post-war developments in Europe have stimulated the production of other products as well as of wheat. From 1923 to 1931 the annual slaughter of hogs in Germany and Denmark increased from under 10 million to over 25. Simultaneously our exports of hog products fell from an amount equivalent to over 12 million hogs to an amount equal to less than 4 million. Not only in eastern and central Europe but in western Europe as well, livestock production has been steadily increased. Heavy duties on lard in many European countries, and export bounties on Polish bacon, have helped increase production. At present, however, the relatively high price of grain feeds behind European tariff barriers may tend toward reducing livestock products and result in decreased production later on. Even in cotton, we have lost our one-time practical supremacy; Indian cotton has become increasingly important, while eventually British empire cotton may be given effective preference in the British market. At least we are fortunate that cotton is not grown in Europe—except in Russia, which is a story all its own. If cotton were raised in Europe, it would surely have been protected by high tariffs long before this.

One class of our agricultural exports is in shining contrast to all the rest. In that class alone the dollar value of exports in 1931 to date has exceeded the value for the corresponding period in 1930; and bids fair to exceed even 1929. That favored class is fruits and nuts; not only citrus fruits, but fresh apples, grapes, peaches, and dried fruits of all descriptions. There has been a rapid upward trend in exports of fruits and nuts since the War. Apparently the low prices of 1931, probably a very elastic demand, and the upward trend in demand, were enough to offset the combined effects of world depression and the general lack of foreign exchange with which to pay for imports. Certainly every American traveler in England this summer was impressed by the fact that grapefruit was available for breakfast as a matter of course, where even one short year before it was a rarity. Unless Europe decides to use duties to restrict her supply of

vitamines as well, there is in this growing demand still one ray of foreign hope left to the American farmer.

The Russian situation is so distinctive that it requires special treatment. In discussing developments in the U.S.S.R., we must be careful not to attribute all progress to the new organization of economic life alone. Communism *is* organizing a constantly increasing sector of economic life on the lines of a planful state socialism; but in addition it is introducing applied science generally in what previously was a semi-medieval country. No outsider can judge whether the economic organization of Russia is as yet superior to that of other countries. There can be no question, however, as to the productive advantages of applied science over the former primitive culture of the Russian peasant. Not only in the technique of production, but in education, in sanitation and health, and yes, even in propaganda, the new Russia is using everything that she can learn from modern science. True, it is often used blunderingly and awkwardly. We must remember, however, that in England and America the machine civilization was not built in one year or even five. Russia is attempting the task of re-making a people, as well as building a new economic system. Whether or not we sympathize with the harsh methods used in the process, we must recognize the substantial progress which has been made. How much of this progress can be attributed to the socialistic economy, and how much to applied science, is a more difficult matter and one that I cannot attempt to answer.

Russia has been slow to re-enter world markets as a food exporter. In spite of all the hardships of revolution and famine, her population has been growing steadily, and more rapidly than population in the western world. Hence a substantial increase in production was needed before a margin for export could be obtained. In 1926, Russian grain acreage reached the pre-war level.[4] It hung at about that point until 1930, when it apparently exceeded pre-war acreage by between 5 and 10 per cent. Harvests were favorable, and for the first time since the Revolution, Russia showed signs of re-establishing her previous position as a large exporter. Russian wheat exports from the 1930 crop amounted to about two-thirds of the average exports from 1909-14. Before the war, however, Russia had also been a large exporter of barley and rye. Exports of these crops, in 1930, showed less recovery than wheat, in comparison to the pre-war

[4] These comparisons are with the average acreage for the pre-war period 1909-13, within boundaries comparable with present boundaries, as computed by the U. S. Department of Agriculture.

averages. In 1931 wheat acreage was further expanded; but the season was unfavorable, particularly close to Black Sea shipping points, and after a fast early start Russian exports have dwindled off. The total shipments for this season are now below those to the same date a year ago. (I can testify personally to the bad weather. We were beastly seasick crossing the Black Sea in a snow storm in April, when all through the wintry north of Russia we had been promised ocean bathing once we got to the Crimea!) Recent reports of very short crops in 1931 indicate that the food situation may become acute within this winter.

It would appear that Russia still has much progress to make before she can re-establish her former position as an exporter of wheat.

In cotton, the Russian record is more impressive. Before the war, she imported 75,000 to 100,000 bales a year from us, and produced about a million bales of her own. Since the war, her production has been steadily increased; even after repeated scaling downs from the preliminary reports, her production for 1931 appears to be in the neighborhood of 2 million bales. During the period of relative freedom for private initiative, under the New Economic Policy, Russian imports of cotton grew to as much as three-quarters of a million bales, largely from us. Part of this was re-exported as cotton fabrics to the Orient. With the inauguration of the Five-Year Plan, production has been speeded up and imports held down; in 1930 the first exports of raw Russian cotton appeared. Last season they amounted to about 150,000 bales. This season heavy offerings have again been reported. The apparent consumption of cotton in Russia was 300,000 bales smaller in 1930-31 than two years earlier. It would appear that in cotton, as in many other products, the standards of living have been forced down to a minimum to provide exports. Foreign "valuta" is very precious in Russia, for machines and tools needed from abroad for the Five-Year Plan must be paid for.

In spite of the industrial progress which has been made, Russia is still primarily a producer of raw materials. The modern product, oil, has been added to wheat and wood as a product for export. Under communism as under the Czar, Russian agriculture must still produce the bulk of the surplus wealth to buy western machinery and equipment to modernize Russia.

A vast quantity of capital goods and a great deal of trained technical skill are still needed to complete the program of industrialization. The pressure to pay still rests on the Russian

peasant—the *mujik*. The present world crisis, with its reduction in the value of wheat and cotton, has borne on Russia no less heavily than on other raw material exporters. The internal operations of the controlled economic system are little affected, apparently, by what goes on in the crazy markets in the rest of the world. There may be elements of stability in the Russian planned economy which the mixed Capitalism and Socialism of other nations has not yet achieved.

Recent dispatches from Moscow indicate that more immediate attention is to be paid to increasing the output of consumption goods. Some of the planned increases in heavy industry for the last year of the plan are to be reduced. One must always be chary of giving full credence to startling reports from Moscow; what actually goes on through the broad stretches of Russia is not always immediately sensitive to changes in official sentiment at the center. It is difficult to judge how significant this reported change in policy will prove to be.

More than once this fall reports have come out that collective farms and even state farms were refusing to give up the allotted proportion of grain, that they were holding on to unauthorized reserves. It may be that this wide-spread passive resistance has convinced the Kremlin that new concessions to the peasants must be made. Certainly standards of food and heating last winter seemed to have reached an irreducible minimum; the further effort of carrying through one year more, with insufficient harvests, may have forced the strain too near the breaking point. Once more, perhaps, the government has sensed the popular reaction, and has yielded just in time to prevent a break from coming. Perhaps this will be the last time such a yielding will be necessary; for the fiscal year 1932-33 will mark the beginning of the next Five-Year Plan, which is to be centered on consumptive goods rather than on basic heavy industries. Each succeeding year, therefore, should see an increase in the manufactured articles available for use, and a relaxation of the tenseness which comes from living in an environment almost barren of all manufactured goods for individual use.

Although much publicity has been given to the great state farms, it is the collective farms which really hold the key to Russian agricultural progress. In the collective farms, the peasants run the farm on an income-sharing basis. The net income is distributed to each man in proportion to the kind, quality, and quantity of work he has done during the year. As in all other Russian institutions, the management and plans of the collec-

tives are dominated by Communist party members; but they work for the common good as they see it, and not for their private benefit.

The year of 1931 was the first one in which the collectives operated over half the cultured land of the U.S.S.R.—the exact figure is somewhere between two-thirds and three-fourths. In comparison, the 5 to 10 per cent operated in state farms is relatively insignificant. With the tremendous change from individual operation to group operation, and with unfavorable weather, it is surprising that the outturn this year was even as good as it appears to have been. Even with the smaller grain harvest, other foods may be more abundant in Russia this winter than last, for livestock of all kinds has been increasing rapidly, and in many regions the production of vegetables, fruit, and vegetables for canning has been expanded sharply. The collectives in the region around Odessa, for example, planted 42,000 acres of vegetables this spring, as compared to 18,500 in 1930, and 7,500 in 1929; while grain crops were reduced from 178,000 acres last year to 138,000 this year. Hogs in the area were increased from 1900 to 3000, and cows from 2550 to 2800. Early in April, when I visited the farms, preparations for planting were well under way, and acres of simple hotbeds and cold frames, with plants almost ready for setting out, reflected the intensive nature of the operations. It was experiences such as this, reflecting the increasing diversity of Russian agriculture, that made me feel that some day the food standards of Soviet Russia would be far above what they had been under the czars.

The question of depreciation of machinery is still a troublesome one. Increasing dependence on Russian-made machinery will increase the rate of depreciation, for a time at least. The poor quality of so much of the manufactured products in Russia is well illustrated by this statement from the *Moscow News,* a quotation from a worker in one of the tractor factories: "The foundry was—and still is—the weak spot. One of the drawbacks is the bad quality of sand and pig-iron. The fact that sand is not graded retards our schedules seriously." This weakness in technical care is characteristic. Russian research workers, scientists, and metallurgists are busy working on the problem—but meanwhile the mechanic in the factory and the peasant in the field go blithely ahead, ignoring the advice of the expensive foreign specialists, until they learn by their own experience how to do the job.

Russia shifted her buying from the United States to England

and Germany because her limited credit was used up here; now she is finding difficulty in meeting her German payments. Already foreign agricultural specialists, payable partly in precious foreign *valuta,* have been dispensed with. If imports of foreign farm machinery are completely shut off, and only Russian-made machines are available, it is a real question whether the transition to dependence on her own machinery can be made without another serious check to the progress of her agriculture.

Transportation is the other weak link in the industrial life of the U.S.S.R. The new steel plants require ore and coal to be moved great distances, as well as the cement, steel, and other heavy products. Vast quantities of new capital must be spent in improving the railways before they will even catch up to the factories already built. The passenger trains run, after a fashion, and the crack expresses are surprisingly good; but freight congestion is evident at every industrial center. Last March, as we went through on the train, coal seemed piled mountain high at every pit-mouth in the great Donetz Basin. Meanwhile workers in Leningrad, Moscow, and state and collective farms alike, shivered in indoor temperatures barely high enough to keep the pipes from freezing. Agriculture and transportation! If the U.S.S.R. can keep them from collapsing, the years of tense effort will achieve success in the end.

Over a long term of years, exports of Russian wheat and cotton may become of less and less importance; although further increases beyond the present level are undoubtedly to be looked for before the turning point is reached. For the present, consumptive standards may continue to be squeezed down to pay for the essential imports. In the long run, more will be kept at home to provide for increasing standards of food and clothing. Even the very program of livestock production itself will eventually require increased quantities of crops to be consumed at home.

It may be that within the next decade the rest of the world will adjust itself to Russia's presence on world markets, in much the same way that after the 1890's, Europe adjusted itself to exports from the United States. Russia seems certain to be an important factor in world trade, short of a complete internal relapse and a reversion to internal anarchy—and such a collapse would benefit neither Russia nor the rest of the world.

At any event, Russia is not the key element in the present world-wide economic prostration. She has gone ahead building and producing while economic paralysis has been creeping over other countries. Russian exports have been large, it is true, and,

at the start, unexpectedly and sometimes bunglingly thrown on the market. Even so, only an infinitesimal part of the blame for the present depression can be placed on her. She has played, perhaps, more the part of the innocent bystander and has herself suffered from the breakdown of the capitalistic machine in the rest of the world.

In trying to judge the future of our agricultural exports, we can not overlook the world-wide repercussions of the national economic policies of the United States itself. Our high tariff policy has consistently reduced the ability of our foreign customers to buy from us. Over the period from 1922 to 1929, our exports grew much more rapidly than our imports. The international accounts could be balanced only because our long-term loans abroad were increased by a net amount of over 4300 million dollars. (Actually we invested much more abroad, but Europeans reinvested about half of it in America.) In addition, 400 million dollars of gold was shipped to us from abroad during the same period. Since 1929, with confidence gone and the flow of new long-term loans abroad dried up to a mere trickle, gold imports increased tremendously. The loss of gold has seriously undermined the gold reserves of Germany, England, Japan, and other countries, and has led to the further financial collapses in many countries.

If we are ever to collect principal or interest on the debts which foreign peoples owe us, our net imports—including services rendered as well as goods—will have to rise above our net exports. The falling-off in our so-called "favorable balance" so far this year shows the tendency beginning to work. Until our confidence in European borrowers is restored, our exports as a whole will meet increased sales resistance in the form of inability to pay. The more we are willing to import, the more we will be able to export.

The reduction in export trade may not fall completely on agricultural products. They do not bulk large in our total exports, and are much exceeded in value by our imports of raw materials such as silk, coffee, rubber, tin, etc. If we continue our national tariff policies, we may develop toward a self-contained economy, with little foreign trade in manufactured products, and with certain agricultural exports paying for raw material imports. Before this could happen, however, there would be a struggle for survival between agricultural and manufactured exports. In this struggle the restrictions on international trade in wheat, already mentioned, would weigh the balances against agriculture. Our

manufacturing industries, however, have already begun to adapt themselved by establishing factories abroad, rather than by trying to export under handicaps. Farm machinery, office equipment, automobiles, automobile parts—these are but a few of the many typical export lines where American concerns have established factories abroad. If this movement continues, the way may be left clear for agricultural exports by voluntary withdrawal of manufactured products. Farming is more individualistic than manufacturing and cannot so readily shift its capital. As yet, I have heard of no American farmers selling out here to farm in England or Germany instead.

Our imported raw materials come largely from Canada, the Orient, and the tropics. These regions have become increasingly important in our foreign trade. From 1910-14 to 1928, our imports from the Americas and Asia increased 231 per cent; our exports to the same regions increased 244 per cent. Over the same period our imports from Europe increased by but 49 per cent, exports to Europe by 76 per cent. Perhaps eventually we shall settle down with our imports almost wholly from these raw-material producing regions, with Europe only an intermediary in a three-cornered exchange. There are no clear signs of such a change as yet, however. Our exports in 1931 to Oceania, South America, and Canada show greater reductions (from 1928) than do our exports to Europe. Exports to Asia, however, show less reduction than to Europe, which may be a significant straw. Certainly wheat, cotton, and tobacco have all been taken in increasing quantities by non-European countries. The quantity of wheat shipped to these countries has been high since 1925. Wheat shipped to non-European countries from the 1930 crop was more than double the average for 1910 to 1914. If we continue our policy of national isolation, perhaps our commercial schools should center on teaching students to talk Chinese, Japanese, and Portuguese—and put German and French on the shelf along with Greek and Latin.

This review of the foreign competitive situation leads to only one sure conclusion—competition in the sale of agricultural products on foreign markets will continue as keen as ever. Severe restrictions on trade will continue or increase so long as prices remain low or declining. Until world economic and political policies are changed, much of the competition will be senseless from an economic point of view, for the highest-cost producers will be encouraged to expand, while the lowest-cost producers will be compelled to reduce and make the needed adjustments.

Present international economic policies might be designated broadly as one of senseless grabbing for oneself. Each nation has been trying to make itself prosperous by hurting the business of other nations. An opposite policy, of international economic co-operation, would look to improving the business of one nation by improving the business of other nations with which it does business. It is difficult to tell when the swing back to such a world policy will commence, or even if it ever will. Perhaps the protectionist developments recently begun in England will mark the highwater mark of economic nationalism; for certainly England can not maintain her previous standards of living under a policy of high protection. Even in the United States there are signs that doubts are beginning to arise as to the ultimate wisdom of a policy of extreme protectionism—but that is a matter of politics rather than of economics, and therefore is beyond the scope of this paper.

More than any other nation, the United States has the power to take steps to correct the conditions which now are steadily strangling international trade. Until those steps are taken, it may be impossible to restore world confidence in the future. The level of prices can not be restored until a sound basis for confidence has been created. Both in domestic markets and in foreign markets, the prices of agricultural exports reflect the lack of confidence and the extreme competition which it produces. As yet, however, there are no signs of effective action to restore international trade.

Discussion by L. A. Wheeler

Bureau of Agricultural Economics

There are two aspects of the foreign competition situation that have not been developed in Dr. Ezekiel's paper, which, I believe, are worthy of consideration. The first of these is the marked expansion of the agricultural production and trade in the southern hemisphere in the last three decades. The second is the tremendous increase in world production of vegetable oil materials, particularly in the tropics. Both of these are of the greatest significance to American agriculture.

The rise of the temperate zone of the southern hemisphere as a factor in world agriculture has been essentially a matter of the twentieth century. The development and improvement of transportation and handling facilities together with the introduction of labor-saving machinery, particularly in grain production, have made the expansion possible. Before 1900, Australia was an important producer and exporter of wool and Argentina and New Zealand exported large quantities of mutton as well as of wool. A beginning had been made in developing an export trade in beef. New Zealand exported a few million pounds of butter and cheese annually. Except for these, the southern hemisphere did not play an important part in world agriculture.

Let us see what has happened since the turn of the century. In 1900, the area under principal crops exclusive of hay in Argentina amounted to about 14 million acres. In 1930, a peak in land under crops was reached at close to 50 million acres. In Australia the increase was on a smaller scale but equally impressive; from less than 10 million acres in 1900 to 25 million acres in 1930. Here then, in these two countries alone, are some 50 million acres of crop land added to the productive capacity of world agriculture since 1900. In both these countries wheat is the principal grain crop. In Argentina the increase in the total crop land was greater than the increase in the land devoted to wheat alone. This was because of the relatively greater rise in the acreage devoted to corn and flaxseed in these countries. Incidentally, the corn acreage of Argentina expanded from a million and a quarter acres in 1900 to a little less than 14 million in 1930. This goes a long way toward explaining the practical disappearance of American corn from European markets. Australia is more nearly a one grain crop country and the increase in wheat acreage over the last three decades has been relatively considerably greater than the increase in the total crop land.

There were, of course, some setbacks in the upward climb of crop acreage in these countries. The major setbacks were during the War. Acreage under crops in Argentina declined almost steadily from 1913 to 1921; in Australia from 1915 to 1919. The scarcity and expensiveness of transportation is reflected in this decline. It was during the same War years that the acreage under crops in Canada made its most spectacular advance. In the last decade, the trend in acreage under cultivation in Argentina and Australia was steadily upward. This expansion of the last decade was accompanied and abetted by an important increase in the use of agricultural machinery; tractors, combines and trucks.

On the side of animal products the expansion in production and exports has also been striking. Exports of Argentine beef, for example, increased from around 50 million pounds in 1900 to an average of considerably over a billion in recent years; Australian wool production jumped from less than one half billion pounds at the beginning of the century to close to a billion in the last few years; the exports of dairy products from New Zealand were equivalent to one-half billion pounds of milk in 1900 compared with six billion pounds at present. While increased numbers of animals have contributed to this large production, it is significant that the increase in yield of wool per fleece in Australia, and in butter fat per cow in New Zealand, has been relatively much greater.

It is clear then that, taking the countries as a whole, very little of this great expansion in Southern Hemisphere agricultural production can be attributed to shifts from one type of agricultural enterprise to another. In fact about the only place that such a displacement has taken place has been in the case of wool in Argentina. Argentine wool production is considerably less now than it was in 1900, as a result no doubt of the increased competition in cattle raising and wheat and corn production.

At the present time we are in the midst of world-wide readjustments and depression in agriculture. The southern hemisphere has not escaped. In the present season the wheat acreage, in both Australia and Argentine, was cut considerably but not as much perhaps as might reasonably have been expected, especially in Australia where the 1930 acreage was undoubtedly abnormally high. In Argentina the cut in wheat acreage was compensated for to some extent by a greater acreage in flaxseed and corn. In Australia, there seems to be a tendency toward a shift from wheat to wool in some areas.

Such shifts and changes are, of course, to be expected in a period such as the present, and it may well be that in the next few years we will see a leveling off,

possibly a decline, in the crop acreage in these countries. But in the long run, I do not think that we can look for any diminution in the competition from the southern hemisphere. The contrary seems more likely. Information on undeveloped agricultural resources, particularly with regard to crop land, is certainly not all that we could hope for, but I think that it can be safely asserted that in Argentina particularly there are considerable areas of land suitable to the production of cereals that have not yet been brought under the plow. With regard to animal products it may be that we need not expect any tremendous increase in the number of animals but the possibilities here have certainly not been completely exploited. The southern hemisphere has not reached its peak as a source of supply for cereals, fruit, and animal products. It is in a position to take immediate advantage of any increase in the effective demand for such products.

As to the effect of all this on the United States I need only point out that Argentine beef and corn have taken the place of American beef and corn on European markets; that Argentine wheat competes directly with American wheat in Europe, and Australian wheat with Pacific Coast wheat, especially in Oriental markets. The threat, or the actual competition, of New Zealand butter in our domestic market acts to depress prices in the United States during our season of low production. South African and Australian fruits in constantly growing quantities compete with American fruit on European markets.

The expansion in production and trade of vegetable oil-bearing materials is illustrated by soya beans in Manchuria; peanuts in China, India, and Nigeria; palm kernels in Sumatra, Nigeria, and the Belgian Congo; and copra in the Philippines, the Dutch East Indies, and the Strait Settlements. It will be noted that most of these are tropical countries having an abundance of cheap labor. In practically every one of these cases, we find that production or exports has at least doubled since prewar years, and in most cases, the increase has been much greater than this. The United States has felt the impact of this increased competition both in the domestic market and in foreign markets. We still find it necessary to export something like one-third of our lard, and the increasing competition of vegetable oil in European markets is a matter of concern to the corn belt of the United States. An interesting and significant aspect of this increase in vegetable oil competition is the distinct trend toward a relatively greater increase in the exports of the oil-bearing materials than of the oil itself from the producing areas to European and American markets. This appears to be particularly advantageous in the case of Europe, where these materials are crushed and the oils used for various purposes, and the residue used for feed and fertilizer.

To this flood of vegetable oils must be added whale oil. Whale oil has been found to be a most suitable material for the margarine industry and for many other purposes, and thus competes directly with vegetable oils and animal fats. In 1909, according to a reliable trade source, the world production of whale oil amounted to about 200 thousand barrels. In 1930 the production was estimated at nearly three million barrels. At this rate it would seem as though the whale would soon be an extinct species, but we cannot be too sure of this. In any case, it is certain that so long as whales are available, the new, highly efficient, so-called "floating factories" can produce an oil that can compete effectively with practically all kinds of vegetable oils and animal fats. But even if all or most of the whales are killed, there still remain seemingly limitless opportunities for the production of vegetable oil materials. It remains to be seen whether the American lard-type hog can survive in the face of this competition. So far as the export markets for lard are concerned, the prospects do not appear bright.

THE WHEAT PROBLEM IN U.S.S.R.

V. P. Timoshenko
University of Michigan

The actual and the potential competition in the world markets for agricultural products on the part of Russia may be appraised only in an historical perspective. Russia and the United States were the largest exporters of agricultural products, particularly of grain, for many decades preceding the World War. Their competition was especially acute on the grain market—particularly on the wheat market—and it developed with changing success for both countries: from the 1870's to the end of the previous century the United States increased its relative position on the European grain market; from the beginning of the twentieth century, during the years preceding the World War, Russia regained to some extent its preponderant position on the wheat market, when America under the influence of the growing interior market receded to second place (or even as far as third place if one takes into consideration Argentine wheat exports).

Characteristic of Russian exports during several decades preceding the World War was the very great importance of the grain exports in the total value of Russian exports. Beginning from the seventies of the previous century, the value of the grain export composed more than a half of the total value of exports. With the development of some other branches of agricultural exports such as exports of eggs, butter, and flax fiber, the relative importance of the grain exports declined a little but it always continued to be, up to the World War, on the level of 45 to 50 per cent of the total value of exports and in absolute value it was rapidly growing: from the 1890's of the previous century to the last years before the War, the value of Russian grain exports about doubled. In this field Russian competition was particularly acute for the United States, while other important branches of Russian agricultural exports (such as eggs, butter, flax, and hemp fiber[1]) did not compete with the United States exports, because the United States was not an exporter of these products. As to the exports of meat, Russia always was rather a weak competitor on the international market; it could not acquire for its meat a large foreign market.

However, in spite of a rapid growth of the Russian grain

[1] Which in 1909-13 composed about one-third of the value of Russian grain exports.

exports during the last decades before the War, its relative importance in comparison to the growing interior market for grain was rather declining. The comparatively rapid industrialization of Russia which took place during the last decades before the War resulted in a faster growth of interior markets for agricultural products. The tendency was the same as for the United States, though less pronounced. The declining rôle of the exports in percentage of the total production for two principal breadgrains may be seen from the tabulation below:

EXPORTS OF WHEAT AND RYE FROM RUSSIAN EMPIRE IN PER CENT OF THEIR TOTAL PRODUCTION
(On the territory of 72 provinces)

Years	Wheat	Rye
1895-1900	26.6	6.7
1901-1905	24.1	6.6
1906-1910	22.8	4.0
1909-1913	21.6	3.4

During a period of about twenty years, the export of wheat declined from one-fourth to one-fifth of the total production, while practically all rye was used for home consumption, with the exception of a small percentage, and during two years this percentage declined one-half. Among other principal grains, only barley exports did not decline during the decades just preceding the War. Barley after wheat was the second important export grain of Russia competing on the European markets with American corn. The favorable tariff policy of Germany for feed barley was responsible for a very rapid development of Russian exports of barley, during the decades just prior to the War, when barley successfully competed on German markets with corn, particularly since 1906 when German custom duties on barley were fixed lower comparatively to the duties on corn. About two-fifths of the total Russian crop of barley was exported.

Thus Russian wheat and barley were the principal products competing with American exports in western Europe. Exports of wheat and barley were rapidly increasing during the last decades prior to the war and they replaced there, to some degree, American wheat and corn, which were more and more used for home consumption, although, for Russian wheat the interior Russian market also became of much greater importance relative to the foreign market.

Such was the situation at the outbreak of the World War, which suddenly stopped Russian grain exports and opened large fields for the expansion of grain production outside of Europe,

particularly in North America. The great expansion of wheat acreage in the United States and Canada was in a great part destined to cover the absence from the west European market of Russian wheat. The Russian revolution and civil war during 1917-1920 prolonged this situation for several years after the War when Russian grain completely disappeared from the world market until 1923. Furthermore, during 1921-22 Russia itself was obliged to import American relief grain.

Russian grain exports were resumed after 1923 but they were much smaller and still less stable than grain exports from the Russian Empire before the War. Instability was always characteristic of Russian grain exports. During the 22 years immediately preceding the War, the average deviation of wheat exports in percentage of the average exports for the whole period was 32 per cent. Not seldom from one year to another exports rose three or four times to be down a year or two later in the same proportion.

Russian wheat exports fluctated much more with the fluctuation of the yield than American exports, which affected the world wheat prices. Russian wheat exports dominated world wheat prices before the war more than exports from any other country as was shown in one of my previous studies.[2]

But the pre-war grain exports from Russia, though fluctuating greatly, did not fall below some minimum quantity, even in the poorest years. It is otherwise with the post-war grain exports from Soviet Russia. It is not only much smaller than the pre-war exports but it became intermittent: only in the years of a good yield do there exist exports of grain from Soviet Russia, while in the years with average or below average yields Russian grain exports cease. After the recovery of exports in 1923-24, grain exports disappear during 1924-25. They recover once more during 1925-26 and 1926-27 when wheat exports attained to from one-fourth to one-third of the pre-war, to disappear once more for three years from 1927-28 to 1929-30. Exports of wheat appear in larger quantity during 1930-31, because the yield of 1930 was exceptionally good as the result of weather conditions especially favorable for crops. Now, in 1931-32, we see once more a decline of the grain exports from Soviet Russia and it is difficult to say how large it would be for the whole current agricultural year. The question arises why are Russian grain exports

[2] See V. P. Timoshenko, "Wheat Prices and the World Wheat Market." Memoir 118, Cornell University Agricultural Experiment Station, Ithaca, N.Y. Revised edition, 1930, pp. 27-32.

so low and so unstable since the revolution and what exports may be expected from Soviet Russia for the next years and for the more distant future? Are the exports small and unstable because production becomes smaller and less stable, or because interior consumption increased? And what are the tendencies for the future as to the possible growth of the production and the consumption and what will be the resultant from them exports?

It is a very difficult problem to make a comparison of the pre-war and of the post-war crop statistics of Russia. Very cautious and scrupulous statistical criticism of both sets of data (the pre-war and the post-war) is necessary as to methods of collection and of publication. It is necessary to say that very often insufficient attention is paid to the problem of the comparability of the pre-war and the post-war crop statistics of Russia. Often official pre-war crop statistics as they were published originally, adjusted only to the new frontier of the U.S.S.R., are compared with the post-war crop statistics communicated by official sources of Soviet Russia and conclusions are drawn directly from such a comparison. Such a comparison leaves, generally, an impression that since 1925 the production of grain in Soviet Russia was as large as or larger than it was immediately before the War and then different explanations are tried to explain why exports are so small.

But these statistics are incomparable as is clearly and openly recognized by official statisticians from such an official institution of Soviet Russia as the State Planning Committee (Gosplan). They consider the pre-war crop statistics an underestimated (in the crop area as well as in the yield per acre) and they correct generally the total grain production of pre-war Russia by increasing it by about 20 per cent. With such a correction the pre-war and the post-war statistics become more comparable. Not all professional statisticians in Russia recognize that the pre-war official crop statistics need to be corrected, but if they have to be used in their original values, then there is no other way to make the two sets of statistics comparable than to lower the post-war crop estimates.

Comparing the total grain production (of all kinds of grains) in Soviet Russia during the years 1925-28 with the pre-war grain production on the same territory, official statisticians of the Gosplan estimate that during these four years, which may be characterized as good or average years, it was on the average

about 91 to 92 per cent of the pre-war (1913=100). It fluctuated from 89 per cent in 1928 to 96 per cent in 1926.[3] Thus, according to official (presumably still a little optimistic) estimates, in no one of these years was the grain production of Soviet Russia on the level of the pre-war grain production. On the average for four years it was from 8 to 9 per cent below the pre-war level. The condition in 1929 was not better. Only for 1930 do the official crop statistics show the grain area about equal to the pre-war level (99.5 per cent) and the total grain production above the pre-war, because the yield was very good. Thus before 1930-31 the exports were low first because the grain production had not recovered the pre-war level.

But the grain production on the average for 1925-28 was given in official statistics as smaller by only from 8 to 9 per cent, while the pre-war exports of all grains composed (for 1909-13) about 13.5 per cent of the total production; therefore with the pre-war size of consumption even such smaller production would leave about 5 per cent of the total grain crop for exports, while only during 1925-26 and 1926-27 it was about 3 to 4 per cent of the total production, and since 1927-28 to 1929-30 grain exports practically disappeared. For this fact may be responsible the growth of the interior consumption of grain. The interior consumption grew not because the per capita consumption of grain increased as was sometimes stated by Soviet statisticians, but simply because the population, during the period 1925-28, was substantially larger than the pre-war population on the same territory. The Census of December 17, 1926, enumerated on the actual territory of the U.S.S.R. 147 millions of population, while on January 1, 1914 the best estimates of the population for the same territory vary from 138 to 140 millions,[4] that is, population in 1926 was from 5 to 6.5 per cent larger. The statisticians of the Gosplan, making a comparison of the per capita production of grain during 1925-28 with the pre-war per capita production, arrive at the conclusion that on the average, for the period 1925-28, per capita production of grain in the U.S.S.R. composed only about 85 to 86 per cent of the pre-war, that is, from 14 to 15 per cent below the pre-war, while the pre-war exports of all grains composed only about 13.5 per cent of the total production. Thus, even with the complete absence of grain exports, the per

[3] See "Control Figures of the National Economy of the U.S.S.R. for 1928-29," published by the Gosplan, Moscow, 1929, pp. 408-412 and note on p. 414.

[4] See as to estimate of the population on January 1, 1914 the *Statistical Yearbook* for 1918-1920 published by the Central Statistical Office, Moscow; also *Control Figures of National Economy of the U.S.S.R. for 1929-30*, Moscow, 1930, p. 436.

capita consumption of grain could not be on the pre-war level during 1925-28. But, as was mentioned above, about 3 to 4 per cent of the total grain production was exported during 1925-26 and 1926-27. This lowers the per capita consumption still more. Since 1926 the population has continued to grow rapidly in the U.S.S.R. The birth rate was the same or only a little higher than the pre-war, but the death rate after 1922 declined below the pre-war. One of the reasons for this may be that severe privations during the civil war and the famine of 1921-22 resulted in a very high death rate during that period and only the stronger people survived the strain of these years. On the other hand, the children's death rate, which was extremely high in the pre-war Russia, declined somewhat after 1922. As a result the growth of population in the U.S.S.R. was statistically estimated for 1924-27 to be about 2 per cent per year, or a little more. By 1929-30 the official estimate of the population of the U.S.S.R. was 158.5 millions.[5] That is from 13 to 15 per cent larger than it was before the War. If during the last years the growth of population was the same (about which we have no data) the population of Soviet Russia must be now about 20 per cent above the pre-war. In such a condition the grain production on the pre-war level (which, according to official statistics, it reached to 1930) can not give any surplus for exports. On the contrary, even without any exports per capita consumption would be below the pre-war. No wonder that in such a case only exceptionally good yield may give some surplus of grain for export or the interior consumption has to be limited by some rationing system as has existed since 1928-29 in order to have exportable grain.

Under such conditions the increase of grain exports from Soviet Russia is possible only with a considerable growth of grain production in comparison with the pre-war. But what are the possibilities for such a growth? They may be manifold in the direction of: (a) an expansion of the crop area on new unoccupied lands; (b) a better utilization of the occupied crop area on account of a decrease of area of idle arable lands (fallow or temporary pasture); (c) replacement by grain of other than grain crops; and (d) an increase of the yield per acre. All these possibilities have to be analyzed from the point of view of short and long periods.

It is a largely accepted opinion that Russia has unlimited possibilities for an extensive expansion of grain production on

[5] See "Control Figures for 1929-30," p. 436.

new unoccupied lands. However, this opinion is based only on a superficial analysis of Russian geographical and natural conditions. The expansion of arable area in the European part of Russia is very near to its limit. The process of the occupation of arable area in European Russia was practically completed before the war. During the last decade before the War the growth of the crop area was rapid only in the southeastern corner of European Russia (North Caucasus). In other parts of European Russia it was slower than the growth of population (even in the southern steppe area). During recent years—1929-31—it was possible to expand considerably the crop area in the southeastern area of Soviet Russia (North Caucasus, Trans-Volga region) only because during the post-revolution years, particularly since the famine of 1921, the crop area here declined much below the pre-war level.

Unoccupied lands good for crop production without special improvement, are still available only in Asiatic Russia, in Siberia, and in Central Asia, but even there the possibilities are much more limited than they are often presented. During twenty years preceding the World War the flow of colonists from European Russia to Asiatic Russia was so rapid that perhaps 6 millions of population crossed the Ural Mountains from European Russia during these twenty years, several hundred thousand of colonists per year. These colonists occupied the larger part of the land fitted for crop production in Asiatic Russia. It is necessary to say that in Siberia only a limited area (mostly in southwestern Siberia) is well fitted for crop production. Because of climatic conditions, the rest is not good for crops. The same must be said about Central Asia where the largest area is dry prairie or desert. Maybe only from one-eighth to one-ninth of the total Asiatic area may be considered as well fitted for crops, and the best agricultural regions were well populated by the flow of colonists before the War. Those regions of Siberia in which lands may be used for agriculture just as they are, without considerable and expensive preparatory work, are actually populated as densely as, or more densely, than the best agricultural regions of the United States. All specialists on the colonization problem in Russia are of the opinion that mass colonization in Siberia and Central Asia, which would permit several hundred thousands of colonists to be settled each year, is over. For some shorter period there are still some possibilities of an occupation for crops of new unoccupied land in Siberia and

Central Asia. The Soviet government is planning to increase the crop area upon unoccupied land in Asiatic Russia during a five-year period on about 12 to 15 million hectares (30 to 37.5 million acres)[6] but mostly in semi-dry regions of Central Asia. The better lands were taken by colonists even in these regions.

There are great possibilities of a better utilization for crops of already occupied agricultural area in European Russia as well as in Asiatic, because a large percentage of occupied arable lands in Russia are left idle as fallow or as temporary pasture (maybe up to 30 per cent), even in the regions densely populated. But a better use of arable land in Soviet Russia is connected with a complete reorganization of the existing agricultural system from a one-sided small grain production on the line of a traditional three-field system to a diversified farming with a smaller percentage of small grain crops. In such a manner the additional crop area on the previously idle crop lands would not result in a larger crop area under grain, but rather in an increase of forage, technical, and root crops. Thus, the grain area can not be substantially increased on account of a better utilization of actually occupied arable land in Russia. On the contrary, diversification of farming which may only permit better utilization of crop land, may result in a relatively smaller area under grain crops, because too high a percentage of small grain crops is typical of Russian agriculture. The tendency to a decrease of the percentage of grain crops may be observed just now. The total crop area increased during recent years in Soviet Russia mostly because other than grain crops were expanded and the percentage of grain area to the total crop area declined from about 90 per cent in 1916 to a little above 80 in 1929-30. The process of a diversification of farming proceeds rapidly in regions of the Ukraine and the North Caucasus, the most important for grain exports before the War.

This also answers the question of a possibility of an increase of grain production in the way of replacement of other crops. The tendency is just opposite, i.e., from small grains to other crops. There is some possibility of the expansion of the area of some particular grain, especially of wheat, on account of other small grains, but not of other than grain crops. Considerable expansion of wheat area is possible in the way of a replacement of rye by wheat, and such a tendency exists during recent years

[6] See the speech of the Commissary of Agriculture at the meeting of the 16th Congress of the Communist party, Pravda, July 12, 1930.

and it is favored by the government. But such a shift from rye to wheat does not increase the exportable surplus of wheat because home wheat consumption must increase in order to replace the rye consumption. As to replacement by wheat of forage grains (such as oats and barley), it is scarcely probable because even now typical of Russia is the great predominance of bread-grains among all other grains. In Russia more than 60 per cent of the total *grain* area is under rye and wheat crops. Such relationship could exist only because the livestock industry of Russia, the feeding of animals, was upon a very primitive level. The natural tendency to expect in Russia is the increase of forage grain production for animal feeding, because the per capita consumption of forage grain for livestock was excessively low in Russia before the War as it continues to be now. The decline in the number of horses and their replacement by tractors is possible to some degree, which may lower the demand for oats, but on the other hand it is natural to expect a growth in the number of cattle and of swine and particularly the improvement of their feeding. This would require the increase of barley or corn production. The government plan for reorganization of Russian agriculture for recent years was directed to a development of the production of forage and of forage grain. Thus it is hardly probable that there will be a shift from forage grains to wheat. The normal tendency would be the opposite. Thus, the growth of wheat production for exports on account of a contraction (curtailment) of the forage grain area cannot be considered as probable for a longer period. It is possible that under the extreme pressure of a necessity to increase wheat exports, the government would try to shift from other grains to wheat, as was seemingly done in 1931, but this may be considered only as a temporary phenomenon and the opposite tendency has to be expected from the point of view of a longer period.

As one of the possibilities to increase the grain production for exports in Soviet Russia is the raise of the yield per acre. The yield per acre of grains in Russia is so low that this gives some foundation to a speculation about a large growth of the yield of grain per acre in Russia during the near future. The plan of the Soviet government is to raise the yield of grain per acre by 35 per cent during five years. But there are too many difficulties which do not permit consideration of this plan as realistic. First, the climatic conditions of Russia are such—semi-dry climate in the most important grain-producing regions, particularly wheat

regions—that it is impossible there to raise the yield of grain, particularly of wheat, to the level on which it is in the more humid regions of western Europe. The standard with which the yield per acre of grain in Russia may be compared is the yield of grains in the United States west of the Mississippi River, or in western Canada. But even this level gives considerable possibilities for a growth of the yield in Russia. During the pre-war time the yield of grain in Russia was not stationary but increased on the average by 1 per cent per year. Russian agricultural economists and statisticians during recent years (1926-28) considered the possibility of the growth of the yield by about 2 per cent per year, which corresponds to the growth of the yield in Germany during the last decades prior to the War, but only under conditions more favorable than those which existed at that time (1927-28) for Russian agriculture.[7] To accept the possibility of a growth of the yield per acre by more than 6 per cent per year as the Soviet government plans would disregard all difficulties in the way of improvement of agricultural techniques and all historical experiences. For these reasons we consider this plan as only fantastic, and the results of the reorganization of Russian agriculture during recent years show that even if there are some achievements from the point of view of expansion of grain areas, there are no visible indications of substantial improvements of yields or of a lowering of costs. As to this last point (costs), we can not enter into a discussion of it because there are no reliable data available. But it is generally known that in all branches of Russian production, not only in agriculture, the expansion of production is not associated with lowering of costs. This is the weakest point in the execution of the Five-Year Plan. It is true that the monopoly of foreign trade, existing in the U.S.S.R., permits disregarding, at least for short periods, the losses on some particular exports, or rather to compensate them by gains on imports if the prices of imported manufactured goods are compared with possible costs of their home production. The state monopoly of foreign trade in Soviet Russia permits direct application to its foreign trade of the principle of comparative costs more rapidly and in a greater measure than it works in a competitive society, where this principle works only slowly and with considerable friction. But even

[7] The rapid growth of the yield of wheat particularly is difficult to expect because the expansion of wheat production is mostly in southeastern semi-dry regions where the yield per acre must be lower than in the western part of the European Soviet Russia (Ukraine, North Caucasus) because of the dry climate.

disregarding the problem of costs there are some physical limits beyond which Russian grain exports can not be developed during short time periods. In addition to the limitation mentioned above there is of importance for a short time period the limitation of draft power existing in agriculture of Soviet Russia.

We hear abroad very much about a drastic effort of the Soviet government to increase the tractor power in Soviet Russia, but it is necessary not to forget that in 1930 there was in the U.S.S.R. a deficiency of from 5 to 6 million horses (that is 20 per cent below the pre-war number) and about 2 million oxen compared to the pre-revolutionary time (1916) on the same territory. This deficiency increased very much from 1929 to 1930 when a drastic campaign for a collectivization was organized by the government. The efforts to increase the mechanical draft power in agriculture in Soviet Russia are directed first to compensate for the enormous previous losses in animal draft power, and only after these losses would be compensated would it be possible to speak of a continuous increase of the grain production in Soviet Russia above the pre-war level in a substantial quantity. But only with such an increase would be possible the continuous recovery of the pre-war exports. For a short-time period the principal limitations for an expansion of grain production in Soviet Russia may be considered, therefore, the shortage of draft power and the difficulties in the reorganization of agricultural production on new lines (collectivization and state farming).[8] For a long-time period the rapid growth of population, the inevitable tendency to shift from grain crops to other crops, and the comparatively limited resources of unoccupied arable land because of unfavorable climatic conditions in the greater part of Asiatic Russia would work against the growth of Russian grain exports. The tendency which existed even before the War for a more rapid increase of the interior market comparatively to the foreign would continue to work in Soviet Russia, particularly if the plan of industrialization should be to some degree successful.[9]

---

[8] See my paper read in the joint meeting of the American Farm Economic Association and the American Statistical Association, December, 1930, *Journal of Farm Economics*, Vol. XIII, N. 2, April, 1931, pp. 280-304.

[9] The points presented in this paper are developed in more detail in a study "Russia as a Producer and Exporter of Wheat" prepared for a forthcoming issue of "Wheat Studies," published by the Food Research Institute, Stanford University.

THE CONCEPT OF MARGINAL LAND

G. M. Peterson and J. K. Galbraith
University of California

Recent years have witnessed a growing interest in the possibilities of a more rational use of land resources in the United States, an interest which has become crystalized in recent months with definite organization for land use planning. The focal point of this interest in land use has in the past, and will probably continue in the future to be not on fertile or favorably situated areas, the agricultural use of which no one questions, but on those areas of such physical character or situation that the returns to production are either meagre or precarious. Areas recently brought into cultivation in the western states, the cut-over lands of the Great Lakes Region and certain areas of the older states where long established cultivation is giving way to abandonment, all exemplify this interest.

A program which might plan to remove certain of these lands from cultivation and seek to prevent cultivation from being further extended in other areas must include recognition of the forces which governed the bringing into use of such land in the first place. Similar recognition must be given the factors which bring about the gradual abandonment of certain land areas now in use. In popular current terminology, a program for the planning of future land use, which may involve some form of zoning of land resources, must carefully consider the forces which determine the location of *the margin of cultivation.* It is the purpose of this paper to examine the forces which under various conditions determine the position of the margin by developing a concept of what may be properly considered the margin of cultivation or marginal land.

Brief mention should perhaps be made at the outset of the common usage of the term "marginal," serving as it does as the text for this paper. In its various applications, the word marginal has perhaps been too glibly used in recent years. As frequently employed, the phrase "marginal land" is apparently little more than a convenient expression for land that is barren, rough, inaccessible, or possessed of other undesirable characteristics or relationships.

The term marginal, whether it be applied to land, production operator, or otherwise, covers a variety of important implications of a scope only partially illustrated by this paper. While

the majority of those who have made use of this term have doubtless realized this to a greater or less extent, the fact that some have used it loosely has detracted from the value of a highly useful and even essential concept. Until such time as all are on common ground, it is strongly recommended that a rather careful statement of the student's position accompany use of the term *marginal.*

Theoretical Margins

As used in economic texts there are two broad aspects of the margin,[1] both of which may apply to changing volume of production by either changing the output on each producing unit, or farm in this case, or by changing the number of farms. Interpreting the first of these for agriculture there are for each producing unit the familiar extensive and intensive margins of cultivation. Assuming price response, these margins are extended with price increments roughly to the point where the extra production is barely remunerated and are similarly contracted with price diminution. This phase of marginality, while lending nothing to the simplicity of the problem, makes it important to remember that there is marginal production on every price-responsive producing unit. The "elasticity" of the extensive and intensive margins for any producing unit or group of units is also of importance in relation to the total volume of production. Within a given area, even where the land is completely utilized in the sense of being all cultivated, a change in the intensity of that cultivation can have a profound influence on the total volume of production from that area. This is especially true for certain crops. As is perhaps more often the case, if the area under consideration contains land of widely varying grades, then the extensive margin for each unit becomes an important contributing factor to elasticity of production.

The second aspect of the margin which applies to changes in the number of units is the one of primary importance for this discussion. This aspect has to do with the land area or production unit which as an entity will retire from production with a price diminution where price is considered the variable. In terms of physical grade of land the economic margin *is at the "poorest" land which can be "remuneratively" operated "under given price, cost, and other conditions."* Herein apparently

[1] See Alfred Marshall *Principles,* Bk. IV. Chap. III, Book V. Chapters VIII-X.

is the key to a definition of marginal land or what is henceforth termed the margin of cultivation and a rigorous analysis of the component parts of the above statement will serve to reveal much of the true character of the margin. First of all we shall examine the constituent parts of necessary "remuneration" and then the various factors which determine whether this remuneration will be forthcoming on a high or low grade of land, i.e., the factors which determine the position of the margin of cultivation or determines whether lands shall be marginal or otherwise.

Remuneration at Margin of Cultivation

The returns or remuneration essential to production on any unit must conceivably include coverage of prime pecuniary costs, conventional returns for the operator and the replacement of capital equipment, variations depending on the length of time to be considered.

Coverage of prime money costs requires little further substantiation as a requisite to continued production except as noted under the heading of "sub-marginal" at the end of this paper.[2] Much more care is required however in the interpretation of conventional remuneration for the operator and the maintenance of capital account.

While the necessary or conventional remuneration for the operator has been considered for agriculture in terms of a definite monetary quantity, there are so many influences tending to make this a highly indefinite amount especially when related to whether production will be continued or not, as to make such usage undesirable. Since at best, money value can be but roughly imputed to those returns from the farm which are in the form of home, food, and other perquisites derived from the farm, it is suggested that some concept of a standard of living be used as the correlative of conventional or necessary remuneration. Standard of living is admittedly in many respects an unsatisfactory concept for quantitative use but it does serve as a composite summary of the necessary returns to the operator, if the farm is to continue as a producing unit. It is moreover quite as specific a quantity as the so-called necessary profits or even the term "labor income," and has less tendency to be misleading. Thus we say that the necessary remuneration of cultivation for any

[2] Whether or not taxes are properly included as prime pecuniary costs essential to production is more or less a debatable point and lack of space prevents discussion in this paper.

one producing unit be such a standard of living as the human element forming a part of that unit will accept.

The matter of capital replacement, the payment of supplementary costs, as an essential to production is very closely associated with the element of time. Various capital investments have a widely varying lifetime from the hay rope which may last five years to the buildings which may serve for seventy-five or even centuries as in Europe. For a period of two or three years, production may be subject to little or no embarrassment though there be no return whatsoever to capital account. Over a longer period certain costs that were supplementary become prime costs and curtailment and cessation of production must eventually follow. For all practical purposes it is to be supposed that certain irrigation works, drainage developments or even buildings may never have their capital remunerated yet production remains unimpaired over an indefinite period.

In this connection it may be pointed out that certain writers have in effect included interest payment, taxes and debt retirement in this present category by placing them among the requirements by which a farm *unit* is marginal or super-marginal. *This is not related to the concept of marginal land.* If a farm unit is taken to be a given area of land in combination with a specific personality and it is considered that the margin is reached (assuming price to be the variable and subject to decline, other things remaining constant) when land and individual are perforce disassociated by any further unfavorable change in the price, then perhaps the inclusion of interest payments and debt retirement is not incorrect. The inference too often drawn that such land is marginal is not necessarily correct, for under such circumstances there is likely to be only a change of operators rather than permanent curtailment of production on the land itself.

Taking another view of the matter, it should be noted that for production to continue does not involve the return of rent to the land. Land capitalization is, of course, but the capitalization of the future earning power of the land and is subject to a vast degree of error. If future earnings are capitalized too highly and payments are not made, then a change in operators may come about. This is ordinarily far removed, however, from the question of whether it is marginal land or of such grade as to be at the margin of cultivation for then, of course, there would be no rent to capitalize.

Factors Which Determine the Position of the Margin of Cultivation as to Grade of Land

What are the factors which determine whether the land which can be remuneratively cultivated will be of a high grade or low grade? First of all it is essential to develop concretely the concept implied in the term "grade of land," and at the same time develop an illustration which should prove of value in making our thinking more specific.

Passing down the westward slope of the Sierras, one encounters a variety of phases of agricultural endeavor. At higher elevations the general topography combined with extensive rock accumulations and insignificant soil formations make cultivation physically impossible. Somewhere on the upper reaches of the slope there is an absolute *physical* margin of cultivation—a margin of cultivation established by the dictates of nature where, because of natural barriers or characteristics, cultivation cannot be carried on.

From this point on down the slope, however, rock out-croppings become less numerous, the soil becomes deeper and more fertile, topography improves, the climate becomes more satisfactory in some respects. Situation value increases with better transportation facilities and proximity to centers of habitation. The term "grade of land" is used herein to convey a sort of composite summary of all these characteristics of the land.

At some point on the slope the grade of land becomes such that it is possible under the conditions of the moment to cultivate the land and fulfill the requirements of the hitherto outlined "necessary remuneration." Presumably forestry and perhaps grazing have been carried on prior to this point on land of a less satisfactory grade. Since cultivation must be defined more or less arbitrarily it will be used here in the sense of actual manipulation of the soil for the purposes of producing crops. Forestry and grazing will be subject to later comment. Needless to say the points where wheat raising and peach production can be successfully remunerated (their margin) will not necessarily coincide, and it is apparent that[3] "margins of transition" from various forms of cultivation and various crops and crop combinations will take place from the lowest to the highest grade of land. Our present purpose is filled by the hitherto defined "cultivation" itself.

The point where it is no longer possible to cultivate remunera-

[3] See D. H. Buchanan, "Economica 1929." *Journal of the London School of Political Science.*

tively a lower grade of land—the uppermost rim of remunerative cultivation on the hitherto mentioned slope—is the margin of cultivation. Subject to some further qualification, that land may be considered truly marginal. Upon what factors is the position of the margin at any given grade of land dependent? This question presupposes perhaps the most important phase of the problem since any approach to the practical problem of the margin must include a broad consideration of the factors which determine the position of that margin. It is proposed to list these determining factors and first consider each one separately and then in the light of its interrelation to the other factors.

Important Factors Which Determine the Grade of Land Which Will Mark the Position of the Margin of Cultivation

A. *Static and Quasi-Static Factors*
   1. The *capacity of the operators* in association with the land and the *standard of living which they will accept.*
   2. The predetermined size of the farm unit.

B. *Dynamic Factors*
   1. The price obtaining for the crops which the specific 'grade of land' under consideration permits of production proximate to the margin.
   2. The prime pecuniary costs of cultivation.
   3. Minor factors.

Before proceeding to the discussion under the above headings, it is important that a distinction be carefully made between the margin of cultivation when the viewpoint is that of a single producing unit, i.e., the poorest land which can be remuneratively cultivated by a given individual, and that margin when the viewpoint regards cultivation or agriculture generally for a particular area comprising many units. The fact that one individual can remunerate his cultivation on a given grade of land does not indicate that such is generally possible for all individuals and it is immediately seen that the margin of cultivation for a given unit *may* be on a much lower grade of land than would be typical for the whole area, considering human capacities in general.

The Capacity of the Operator as a Factor in Determining the Position of the Margin

The human factor in determining the position of the margin is a variable in two important respects—as to his ability or ca-

pacity for remunerative cultivation and as to the standard of living which he is willing or able to accept. Inclusion as a quasi-static factor in determining the margin is based on the assumption that neither capacity nor standard of living change rapidly.

It is reasonable to suppose in the light of the discussion up to this point, that the *absolute economic margin* of cultivation for a particular unit at a given time is found where an individual with the highest capacity for production, accepting the lowest possible standard of living, is operating the most efficient size of a farm of *the lowest grade of land* that will remunerate his cultivation at prevailing prices. Such a case is purely hypothetical and embodies certain inconsistencies but furnishes the first step toward making possible a generalized statement.

On the basis of averages, leaving now the concept of the individual unit, we may say that the margin of cultivation for an area of varying grades of land, or our hitherto mentioned mountain slope, is at that grade of land which is the lowest (grade) that can be remuneratively cultivated by the operator of average ability or capacity accepting a standard of living such as is on the average the lowest which would be accepted by farm operators in that area.

The above statement, however, is immediately confronted with the dogmatic, if unproven, hypothesis of the combination of factors of similar efficiencies by a sort of natural selection—the process of inverse selection by the land of its operators. To the extent that this is true, then a consideration of land near the margin of cultivation must also keep in mind the fact that the operators available for such land are below average capacity. They are further perhaps amendable to a standard of living that is considerably below that which might be considered the lowest that those representative of the average would accept.

In view of the factors considered so far, it is suggested that *the general margin of cultivation for a given area of varying grades of land is at that particular grade which, with an operator representative of the capacity of operators generally associated with about that grade of land, barely remunerates its cultivation.* Included in that remuneration is a standard of living which is the lowest the operator representative of his particular group will accept.

Stated in other words, in an area of progressively lower grades of land, the general margin of cultivation is at a grade of land which is better than that which might be remuneratively

cultivated by the very best operator when such remuneration embodies the lowest possible standard of living, and is as much better than the grade which can be remuneratively cultivated by operators of average capacity as there is weight in the hypothesis that low grade land tends to select low grade operators with a lower standard of living acceptable to such operators.

Returning again to the consideration of the margin from the standpoint of the individual unit, it is to be noted that if one individual of given capacity is unable to remunerate his cultivation on a grade of land higher than the hitherto noted "absolute economic margin," there is still possibility that some other individual of higher capacity will be able to do so. The chances for such a substitution are very low for low grades of land (giving rise to the foregoing statement, in an area as a whole, of the general margin of cultivation) but the probabilities of this substitution become progressively greater with progressively higher grades of land until they merge with substitution arising from the return of rent to the land as earlier indicated.

The Predetermined Size of the Farm Unit as a Factor Influencing the Position of the Margin of the Cultivation

The term "grade of land" has been taken to include such physical relationships as soil fertility, topography, climate—in fact all the "free and indestructible" elements including its situation which affect its relation to agricultural production. Different from this only in being the specific effort of man is the size of the unit upon which agriculture is to be carried out as earlier determined by the original settlers or surveyors of the land. While not of broad theoretical importance, the predetermined size of the farm unit has considerable practical significance in determining the lowest grade of land to which cultivation can be remuneratively carried.

In all established agricultural areas a greater or less degree of difficulty is encountered by the operator who endeavors to adjust the land area he operates to his particular capacity. Earlier surveys and farm boundaries together with the more or less fixed nature of surrounding tenure constitute very definite resistances to such adjustments. This situation, insofar as it obtains, will place the margin of cultivation at a higher grade of land than would be the case were it possible to adjust the land area to the operator's capacity in each case and to changing conditions.

It is very reasonable to suppose that the margin of cultivation, considering the grade of land to cover the same physical factors in each case, has extended to lower grades of land in more recently developed western areas than is now possible in older eastern areas where agriculture is more or less committed to small and "unadjustable" holdings.

The Price of Products Subject to Production near the Margin as a Factor Influencing Its Position

A factor of prime importance in its influence on the position of the margin of cultivation through time, is the price of the products which are capable of production near the margin of cultivation. It is obvious that with every change in the price of such products, other things remaining constant, the grade of land which will just remunerate its cultivation will require redefinition. Other things remaining constant, price increments will make the cultivation of a lower grade of land possible while the reverse condition will obtain with price diminution.

Perhaps a further word is desirable in reference to the "products capable of production near the margin." These will most certainly not be the same for any two areas since our definition of the grade of land is of necessity a changing one. For any given area, however, as the lower grades of land are approached, the production of the various crops will meet resistance in one physical factor or another of those which are the component parts of our definition of grade of land. As the margin of cultivation is approached, the effect of these physical factors will not be to bring about a change to some other crop or crops but will rather embody the choice between growing certain remaining crops or none at all. The profound influence of price in determining the margin of cultivation will be through these remaining crops and this influence will operate when, in the case of a price decline, the possible return from a producing unit is lessened thereby.

A point of considerable practical significance, that has received little attention, is encountered when it is reasoned that the effect of an important price increase is of more importance in its influence on the position of the margin than a price decline of similar magnitude. The possibility of future reward under the new price condition following a price increment will tend in general to extend the margin of cultivation to the inclusion of lower grades of land. This is accompanied by an ininvestment of capital in the fixed equipment for production on

the new area. Once made, such capital investment is almost entirely incapable of liquidation. Hence by a process of unconsciously writing down and writing off the capitalization, production may continue on the land, may remunerate prime pecuniary costs and return the operator a standard of living under subsequent price conditions which render nothing to capital.

This general line of reasoning may also be profitably carried to a consideration of the relative effects of increases and decreases in price on the intensive and extensive margins for a single producing unit. It is entirely probable that the purchase of machinery, provision of buildings, drainage, etc., under the motivation of high prices may tend to keep production at a high point even after prices have again declined, for reasons similar to those outlined above. It may be possible that there is a higher degree of mobility of these margins on a given farm and particularly in the intensive margin than is to be found in the margin of cultivation itself which, as discussed here, involves the question of the whole unit going in or out of cultivation.

It is perhaps a mistake to divorce price entirely and regard it as a strictly exterior factor affecting the position of the margin for it is obvious that the increased production resulting from an extension of the margin will in turn have some bearing on the price. Thus in a broad aspect, prices of the products and the position of the margin of cultivation are theoretically interdependent.

Costs as a Factor Influencing the Position of the Margin

The remuneration of cultivation includes certain prime pecuniary costs. Changes in the amount of these costs will influence the position of the margin, e.g., a lower grade of land can remunerate its cultivation if costs decline. It is reasonable to assume that changes in the cost conditions for wheat production had a profound influence on the position of the margin of wheat production and the position of the margin of cultivation itself, in the Great Plains Region. In general the effects of cost changes are similar to the effects of price changes on the position of the margin except that they are usually less abrupt and are of relatively smaller magnitude.

Two further factors may be mentioned as of some importance in influencing the position of the margin. The first of these is time which is mentioned here to draw attention once more to the discussion under necessary remuneration for capital. Should

everything else become a constant quantity—price and costs remaining indefinitely the same—the position of the margin of cultivation as now constituted would undergo a change throughout the years by virtue of the wearing out of capital equipment for which no return was being made.

The capital which is available for the extension of the margin of cultivation is a further factor which may be mentioned as influencing its position. That such capital has always been available in perhaps too large quantities in the past does not necessarily foreshadow a similar situation in the future and as a determining factor it should at least be kept in mind. In a similar vein, the supply of human "initiative" for the extension of the margin may also be mentioned though this point is subject to later comment.

Relation of the Margin of Cultivation to the "Opportunity" Margin for Non-Agricultural Use

Professor Davenport points out that[4] "Marginality of production . . . is not a matter of absolute gain but of relative gain." It is next essential that we inquire how the foregoing analysis derived broadly from the Marshallian usage of the term marginal is reconciled with the widely accepted concept of the opportunity margin.

As we proceed from higher to lower grades of land, it may be that before the margin of cultivation as heretofore established is reached, the alternative advantage for that land in grazing, forestry or for recreation or even wilderness is equal to that derived from cultivation. Land which promises equal return from cultivation and say forestry may properly be considered at the margin of cultivation.

The concept of the opportunity margin is one of importance from the standpoint of accurate thinking but its practical significance for our present purpose is much in question. For the individual unit the margin of cultivation in the absolute sense is probably reached before the opportunity margin for use of the land in forestry or similar employment with the possible exception of grazing. It has been repeatedly argued, however, that the social viewpoint is not in accord with the individual viewpoint in many such instances especially where forestry is involved.

Under present conditions, however, whether social requirements in the form of forests, recreation areas, or watershed pro-

[4] Davenport, H. J. *Economics of Enterprise*, Chap. VI, p. 78.

tection be great or small, they cannot be said to express themselves to the operator of a farm unit as a remunerative alternative to the cultivating of farm crops. The reason for this may well lie in our taxation arrangements or because the period of forest growth is too long for the "prospectiveness" of human enterprise. A scepticism on the part of private enterprises as to the validity of our present worries about a great forest shortage in the future may be as good a reason as any.

Whatever the reason, the statement is here made that such so-called social needs as forests, recreation areas, game preserves, wilderness, etc., do not at the present time constitute a force of any importance in determining the margin of cultivation through the opportunity margin for non-agricultural use by individuals.

The most important concept embodied within the opportunity margin has regard to the opportunity margin for the operator rather than of the land. In many periods it is entirely probable that land has not and may not be cultivated to the possible margin *because the opportunity margin for the operator's efforts in other lines of endeavor than agriculture is equivalent to the return at a grade of land which is considerably better than that grade which will just remunerate its cultivation.* The margin of cultivation then becomes a direct function of the supply of agricultural workers and enterprisers as modified by the technical changes, immobility of the farm population and other factors included herein which continue to exert greater or lesser influence.

Essentially Shifting Character of the Margin of Cultivation

The forces discussed above indicate that the margin of cultivation in abstract theory at least is a highly mobile or dynamic concept. This stands out in some contrast to what is probably a growing tendency to regard the margin of cultivation as at a more or less definitely fixed physical grade of land.

When, however, it is considered that the very best fixed or static definition as to what constitutes marginal cotton lands would be of but remote historical interest from either a practical or theoretical standpoint a few years from now, were cotton prices to treble in the interim, the approach taken herein is much more nearly justified. This is further the case if consideration is given to the probable present status of such a definition of wheat land made twenty years ago. Both wheat and cotton illustrate rather well the present discussion of the margin of cultiva-

tion since they are crops that for their respective areas are adapted to production on the virtual margin of cultivation.

It is further seen that, from a unit standpoint, there can be a broad range between the grade of land which constitutes the margin of cultivation for one unit and that grade which is marginal for another unit. Otherwise expressed, while the dynamic factors influencing the margin contribute to a change in its position through time, the static factors contribute to a wide variation between the grades of land which may be marginal for any two units. The grade of land which is marginal for the highest in human capacity, accepting a low standard of living and operating the most economical size of unit, will apparently be much lower in grade than that land which is marginal for the unit comprising uneconomical size and a low capacity operator demanding a high standard of living. These cases are of a hypothetical nature and show certain internal inconsistencies, *viz.*, high capacity and low standard of living, but give some conception of the depth of the problem from the unit standpoint. Now with a change in a dynamic factor such as price, this whole range will tend to shift toward a higher or lower grade of land.

It is needless to point out that an actual attempt to define the margin of cultivation for an area would reveal no such smooth working out of the various factors affecting the margin as is indicated above. Actual approach to the problem of land planning cannot group all physical factors into the term "grade of land" as so conveniently done in this paper but will need to consider each of these physical relationships as a resistance to remunerative cultivation. It will be further recognized that fertility, and even climate change through time, and that shifts in population greatly affect "situation" value through price of products or costs. While the actual problem will go much further in these matters than is indicated in this paper, a practical approach will have to take certain things for granted that are thought through in some detail herein. Standard of living and human capacities will have to be handled by some more or less arbitrary method. (See earlier discussion of "general" margin for an area.) The application of the principles sketched in this paper is a problem which would go far beyond the scope of the present discussion.

However, it is important to note that, theoretically at least, the grade of land which can be considered as representing the margin of cultivation for units of land going out of use (capital

committed) is lower than the grade of land to be considered as marginal for units of land coming into use. It is also important to note that the grade of land to be considered as marginal for any long-time planning operations may be of such high quality that at present it appears to be supra-marginal. If population becomes stationary but agricultural improvements continue, then many farms that appear to be good at present will have to be abandoned.

The Sub-Marginal Concept

Part of the confusion which one finds in the usage of the term sub-marginal arises from the fact that several things are described as marginal without clearly distinguishing which is being referred to at the time.

The terms marginal and sub-marginal are loosely applied to land, operator and production more or less interchangeably. The problem of what constitutes a marginal operator is one quite commensurate with the present discussion of marginal land. Is a farmer marginal because he is on marginal land or because his capacity is so low as to be the most important contributing factor to a breaking up of the production unit of which he constitutes an integral part with price diminution or is he marginal because he has committed himself to making fixed payments out of proportion to the grade of land he is operating even though it be of an exceedingly high grade and far above the margin of cultivation?

Likewise the term marginal production must always be used with a statement as to the element or elements upon which the marginality of production is dependent. Production at the margin of cultivation is properly called marginal. Moreover, it has been shown that this margin of cultivation is at a different grade of land when considered from the standpoint of the individual unit than when generalized to the grade of land which is the locus of the margin of cultivation for a large number of units. Further, if the concept of marginality is applied to the operator, without questioning the validity or wisdom of such application then production from a unit which embodies a marginal operator must also be considered marginal production.

Turning now to a consideration of the sub-marginal concept, it is apparent from the reasoning employed in establishing the nature of the margin of cultivation, little room is left for the frequently mentioned production on sub-marginal land. This is

particularly the case when the viewpoint is that of the individual unit.

However, if a generalized margin of cultivation is arrived at for a given area on the basis of some sort of average for the static factors influencing the position of the margin, then perhaps it is not incorrect to consider that the individual units operating on a grade of land lower than this margin are carrying on production on sub-marginal land. It remains of questionable desirability to say that such production is sub-marginal, whether such production is made possible by a debased standard of living on the part of the particular operator or by extraordinary capacity in remunerating his cultivation. The fact that some assumptions must be made as to standard of living and capacity may in the future indicate a valuable approach to the practical problem.

From the standpoint of a single production unit, production may be carried out on sub-marginal land when it is made possible by the following conditions.

(1) Where the operator is using credit, personal reserves or other methods of maintaining or remunerating his cultivation.

(2) Where governmental agencies "subsidize" the production on land of a grade too low to remunerate its cultivation by contributing such share of schools, roads, or other services as should be included in the necessary remuneration which the land renders from its cultivation. This point has considerable practical significance in its relation to problems of social expenditure and policy, and will bear detailed analysis.

(3) Where cultivation is carried out on a grade of land for which the opportunity margin in some other use has been reached and passed from the standpoint of the unit itself.

There are a number of phases of production on sub-marginal land indirectly included in the foregoing in part, one or two of which are worthy of special mention.

The wealthy owner of a barren ranch, its land distinctly sub-marginal from the standpoint of remunerating its cultivation in the hands of anyone who might attempt to do so for a living, may derive sufficient psychic return or prestige from its ownership and operation to make him willing to pay the difference between the costs of cultivation and the return therefrom. A step removed from this is the absentee owner who retains land similarly below the margin and finances its cultivation as a sometime home. Such instances are of some economic importance and

are related to the next example which is of significance. The small farmer who derives the major share of his income from roadwork or a similar source, perhaps even city employment, cultivates land on the farm which renders him a home that is perhaps strictly sub-marginal—sub-marginal from the standpoint of remunerating its cultivation were it the only source of such remuneration. The farm and home, standing as they do somewhat in the nature of a supplementary enterprise to the organization of the individual's activities, permit of production on sub-marginal land in a way that is not probably in any sense uneconomic.

The concepts presented in this paper are admittedly of an abstract and perhaps elusive character. Such, however, is the nature of economic theorizing and so long as it is to form the point of departure for practical work in agricultural economics, it must be given thoroughgoing consideration. Approach to the problem of marginal lands must be based on some such background as is presented herein. The careful development of such a background promises in turn to lend much in the way of practical approach as well as furnishing the nucleus around which logical procedure must center.

Finally, the position taken early in this paper is reiterated—that the nomenclature surrounding the various applications of the term margin be kept clear and specific as an invaluable aid in formulating a common approach to the related problem.

EFFECTS ON AMERICAN AGRICULTURE OF A DUTY ON PHILIPPINE COCONUT OIL AND COPRA

PHILIP G. WRIGHT

This paper has to do with a duty on coconut oil from the Philippine Islands, whether entering the United States in the form of oil or copra.[1] It touches the question of Philippine independence only to the extent that the granting of independence, unless Congress takes supplementary action, would extend to the Philippine Islands the duty of two cents a pound on oil now applying to other countries. Such a grant of independence would not affect copra, since that is now admitted free of duty from all sources. Hence, unless a duty is imposed on copra, the duty on coconut oil resulting from independence would have no appreciable effect on the price of coconut oil in the United States and hence, no effect on American agriculture. Oil would continue to be imported free of duty in the form of copra instead of in the form of oil. The duty would cause that part of the crushing industry (about half) now resident in the Philippine Islands to move to the United States. In this paper, therefore, it is assumed that the tariff will be so adjusted that Philippine coconut oil and oil from all other regions will become dutiable whether imported in the form of oil or of copra.

1. Partial Interchangeability of Oils

Animal and vegetable oils, because of similar chemical composition, are partially interchangeable. Experience and experiment, however, have shown that for each use one particular oil or blend of oils gives the best results. Substitution results in an inferior product. In many cases, indeed, substitution is impossible.

2. Chief Uses of the Animal and Vegetable Oils and Fats

This class of oils is used (1) for food, (2) for soap, (3) for paint and varnish, (4) for a great variety of minor uses.

(1) Food oils are of two kinds: (a) table oils, as butter, margarin, and salad oil; (b) cooking oils, used in "shortening" and frying, as hog lard and lard substitutes derived from vegetable sources.

[1] Copra is the dried meat of the coconut from which coconut oil is expressed.

(2) Any oil can be used in soap-making, but the character, appearance and quality of the soap depends on the process, the oils used, and the proportions in which they are blended.

(3) Oils used for paints and varnishes are called drying oils. Only a comparatively few of the oils contain the chemical ingredients which cause them to harden when exposed to the air and hence make them "drying oils." Coconut oil has not these ingredients, hence it cannot be substituted in any use calling for a drying oil. Therefore, such oils will receive here no further consideration.

(4) Minor uses. These are numerous, but the only ones applying to coconut oil are uses in the confectionery trade, cosmetics, perfumes, ointment, and salves.

3. Reasons for the Demand for a Duty on Philippine Coconut Oil

Advocates of such a duty claim: (1) it would benefit dairymen by increasing the price of margarin and hence of butter; (2) it would benefit agriculture generally by giving farmers the opportunity to produce more oil-bearing seeds, especially soya beans, the oil from which would replace the excluded coconut oil.

4. Coconut Oil as a Competitor with Domestic Oils

The duty could attain the first end only to the extent that it would increase the price of margarin, and the second end only to the extent that domestic oils may be substituted in uses now occupied by coconut oil.

We will first consider the uses to which coconut oil is now applied. These were in 1929 (with quantities consumed in millions of pounds and percentages):

Coconut Oil[2]	*All Industries*	*Soap Making*	*Margarin*	*Biscuits, Confectionery and Other Food Uses*[2]	*Miscellaneous*
Quantity	652.6	393.9	185.5	72.1	1
Percent	100	60.3	28.5	11.0	0.2

We will next consider, one by one, the domestic oils and fats with which coconut oil is alleged to compete.

---

[2] These data are from Bureau of Census Bulletin: *Factory Consumption of Animal and Vegetable Fats and Oils for 1929*. The column here headed "Biscuits, confectionery, and other food uses" is in the Bulletin headed "Lard Substitutes" with the explanation that "Lard Substitutes includes mayonnaise, salad oils, and other similar food products except oleomargarine." This heading, "Lard substitutes," is in the case of coconut oil very misleading. Relatively little coconut oil is applied to this use. The following estimate of the distribution of coconut oil among its several uses appears in the brief submitted by F. M. Barnes, representing the American Laundry Soap Manufacturers' Association, at the *Hearings* before the Committee of Ways and Means, 1929, page 8952. Soap, 61 per cent; margarin, 24 per cent; candy and biscuit trade, 12.5 per cent; lard substitutes 2.5 per cent.

Butter. Coconut oil can compete with butter only through its use in margarin, a substitute for butter. Margarin is generally regarded as inferior to butter. The fact that margarin is a substitute indicates competition, but the further fact of inferiority indicates competition on different price levels. Obviously if the cost of producing margarin were so increased that it could not be profitably sold at a price less than that of butter, most persons now consuming margarin would change to butter, since it is regarded as superior, and the increased demand would raise the price of butter, at least temporarily. In the long run the increased price would lead to an increase in output, which in turn would restore the former price level—a price level which it may be assumed is based on the marginal cost of production. The reverse chain of results would follow if the cost of producing margarin were greatly reduced. The question is, therefore, how much would a duty of two cents per pound on Philippine coconut oil raise the price of margarin.

The total output of butter in 1929 was about 2.1 billion pounds, that of margarin about 349 million pounds, or 16.6 per cent that of butter. In the manufacture of these 349 million pounds of margarin, 185.1 million pounds of coconut oil were consumed. The average price of butter in 1929 was 45 cents per pound and that of margarin 23.5 cents per pound.[3] A duty of 2 cents, *if fully effective,* would raise the price of coconut oil two cents, but since coconut oil is only one of the ingredients it would not raise the price of margarin so much. It should in fact raise the price $\frac{185.1}{349.0}$ of 2 cents or about 1 cent. Whether so slight an increase in the price of margarin would have any appreciable effect in diverting consumption from margarin to butter and hence increasing the price and output of the latter there is no means of telling. Obviously the effect at best would be very slight. Moreover, a 2 cent duty would not in all probability raise the price of coconut oil by 2 cents, as the normal effect of a duty is in part to raise the domestic price and in part to depress the foreign price. The one cent estimated increase in price is an average for all margarin. The kind not containing coconut oil would not, of course, be affected. The kind containing coconut oil, "nut margarin" would be raised in price by more than one cent.

[3] The data for production of butter and margarin, for consumption of coconut oil in margarin, and for prices of margarin and butter are all from *Agricultural Yearbook,* 1931. The price of both butter and margarin fell off in 1930, butter to 37 cents and margarin to 21.8 cents. There has been a still further fall in 1931.

Other animal fats. Lard, tallow, greases, oleo oil, and stearin, all show so large a surplus production for export that a duty on coconut oil, even were it fully effective could not affect the price. It might, however, affect the distribution. The two chief uses of coconut oil are for soap making and margarin. Inedible hog and beef fat and the greases are also used in soap making, and oleo oil and stearin in margarin. A higher price of coconut oil might divert some of the present exports of lard, oleo oil, and stearin to margarin. It could hardly divert to domestic uses the other fats and greases mentioned because these exports consist of materials which, while classed as inedible in the United States, are refined into edible products in Europe and there receive a better price than is paid for such materials by soap makers. In no way could such a diversion affect the interests of farmers producing oil seeds.

Cottonseed Oil. The distribution of this oil among its principal uses is as follows (millions of pounds and percentages):

Cottonseed Oil[4]	*All Industries*	*Soap Making*	*Margarin*	*Lard Substitutes, Salad Oil and Other Food Uses*	*Miscellaneous*
Quantity	1,372.3	167.0[5]	30.2	1,161.8	13.2
Per cent	100.0	12.2	2.2	84.6	1.0

It will be seen that the principal uses of cottonseed oil are in the production of lard substitutes and salad oil, these uses absorbing nearly 85 per cent of the total production. Of this 85 per cent, by far the greater part is for lard substitutes. Cottonseed oil is peculiarly adapted to the requirements of a good cooking oil. Alone or blended with other oils, it can be used in liquid or solid form. It does not smoke or foam or sputter. It has also good "shortening" properties. As a salad oil it ranks high, though inferior to olive oil. Coconut oil, on the other hand, is not suitable for either of these uses. It does not emulsify and is solid at too high a temperature for a salad oil; as a cooking oil it is deficient in "shortening" properties; and when used in frying it smokes and foams and sputters. The most important use of coconut oil, however, is in soap-making. For present-day soap it may be said to be almost indispensable. No other oil is so satisfactory in giving good lathering properties to the soap, a consideration of great importance when hard water is used. It also lends itself to producing the whiteness now desired in soap. It

[4] From Bureau of Census Bulletin: *Factory Consumption of Animal and Vegetable Fats and Oils*, 1929.

[5] The quantity set down as used for soap making (167 million pounds) consists, practically, only of the so-called "foots" or refuse from refining.

is probable that even if the price were increased by a duty it would still be imported—a burden to consumers without benefiting cotton growers. For as shown in the footnote to table above, only an inappreciable percentage of the cottonseed oil output goes to the soap kettle, practically only the refuse from refining. The demand for it for food purposes is so strong that for these uses it commands a higher price than it can obtain from the soap maker where it must be in competition with cheap, inferior oils and fats, as well adapted to soap-making as it is.

Finally, cottonseed oil is in its chief use competitive with lard, of which there is such an enormous export surplus that its price is fixed in the world market and, moreover, cottonseed oil is still itself on a small export basis—about 1.5 per cent of the crop.

It thus appears that a duty on coconut oil could in no wise benefit the cotton grower.

Corn Oil. The distribution among its principal uses is as follows (in millions of pounds and percentages):

Corn Oil[6]	*All Industries*	*Soap Making*	*Margarin*	*Lard Substitutes, Salad Oil and Other Food Uses*	*Miscellaneous*
Quantity	56.8	25.6[6]	0	25.5	5.7
Per cent	100.0	45.0[6]	0	45.0	10.0

A comparison of the uses of corn oil as given above with the uses of cottonseed oil will show that a duty on coconut oil could no more aid the corn grower than the cotton grower, and partly for the same reason—the uses to which corn oil is particularly adapted are uses to which coconut oil is not adapted and vice versa. The truth of this statement becomes even more apparent when it is remembered that corn oil is only a relatively unimportant by-product of corn.

Peanut Oil. The distribution among its principal uses is as follows (in millions of pounds and percentages):

Peanut Oil[6]	*All Industries*	*Soap Making*	*Margarin*	*Lard Substitutes, Salad Oil and Other Food Uses*	*Miscellaneous*
Quantity	11.9	1.7[6]	6.3	3.6	.3
Per cent	100.0	14.3	53.0	30.2	2.5

More possibility would seem to exist for competition of coconut oil with peanut oil than with any of the oils yet mentioned. Since a major use of both coconut oil and peanut oil is found in the manufacture of margarin, it would appear that a higher price of coconut oil would improve the margarin market for peanut oil. However, this extension of the market for peanut oil is

[6] Consists in part of the "foots" or refuse from refining corn oil for edible purposes.

more limited than would appear on the surface. Margarin is a blend of oils or fats and other substances, and if it is "nut" margarin (because of a ruling of the Bureau of Internal Revenue), the only oils available are coconut oil and peanut oil. This kind of margarin is composed of about 78 per cent fat and 22 per cent milk solids, salt, and water. In this fatty portion, peanut oil may be used as one of the ingredients but it cannot constitute the whole of it. It has not the required properties. The greater part must be coconut oil. However, the remaining portion may be in whole or in part hydrogenated peanut oil. Here there is some latitude for choice based on the price of the oil. However, it should be noted that if peanut oil is to be used in "nut" margarin, coconut oil must also be used, and that at best the peanut oil can constitute only from 10 to 20 per cent of the total weight of the margarin.

Moreover it is doubtful whether peanut growing would be appreciably extended by making coconut oil less available and hence opening to peanut oil this somewhat restricted market. At present the price of peanuts for the purposes of manufacturing into peanut butter and for sale as peanuts in the confectionary and grocery trades is so much better than can be obtained when they are crushed for oil, that farmers do not purposely raise peanuts for crushing. The imperfect peanuts, the "culls," unmarketable for the former purpose are, however, crushed for oil, and, as shown above, much of the oil so produced is sold for soap-making. In its soap use the duty on coconut oil could not improve the price of peanut oil because here it must compete with cheap animal fats and greases, fish oils, and with other cheap oils equally well adapted for the production of soap.

Soya Bean Oil. The distribution among its principal uses is as follows (in millions of tons and percentages):

Soya Bean Oil[4]	*All Industries*	*Soap Making*	*Margarin*	*Lard Substitutes, Salad Oil and Other Food Uses*	*Miscellaneous*
Quantity	17.9	6.4	0	0.1	11.4
Per cent	100.0	35.8	0	0.5	63.7

The table is somewhat misleading as the present duty on soya bean oil precludes a more extended application to soap-making, a use to which it is well adapted. However, the high percentage under "miscellaneous" is instructive. This column includes paint and varnish making and all manufacture calling for a drying oil. This is the chief field of use for soya bean oil, and in this field,

of course, its use cannot be in any way affected by a duty on coconut oil. Finally soya bean oil may be applied to food uses, but for this purpose it is not so satisfactory as some of our other domestic oils. Even before the duty was first imposed in 1921 its consumption in food uses was rapidly declining. It is doubtful if it would be so used to any appreciable extent even if the duty were removed. It is still used in soap making and before the duty was imposed was extensively so used. In this use, however, it is not a substitute for coconut oil but may be used with it. In fact, in making a modern soap, soya bean oil calls for a higher percentage of coconut oil in the formulas than do other domestic oils and fats.

However, as the hope of developing a strong domestic soya bean oil producing industry is advanced as one of the reasons for a duty on coconut oil, the case deserves attention. There is, however, little or no reason for thinking that such a duty would bring about such a result. This opinion is based on the following considerations:

A higher price of coconut oil could have no possible effect in extending the market for soya bean oil in its principal use as a drying oil.

In order to develop a strong soya bean oil producing industry, soya bean oil would have to command a higher price for its soap and food uses than at present. At present there is an immense acreage of soya beans in the United States. They are grown, however, as a forage crop or are plowed under for "green manure." The present price is not sufficient to induce farmers to harvest the beans to any considerable extent for crushing. They are harvested for seed and the excess over the demand for this purpose is in part exported and in part crushed.

Soap makers and margarin and lard substitute producers would not pay a higher price for soya bean oil. If the price of coconut oil were raised, they would, for reasons stated in previous paragraphs, either pay the higher price and pass the burden on to consumers, or, when possible, substitute some other oil or fat more desirable for their purpose than soya bean oil.

Soya bean oil producing is handicapped by an excess of cake. The percentage of oil contained in the soya bean is small compared with that in other oil bearing seeds. In considering an oil crushing industry attention must be given to the joint income derived from oil and cake. With each ton of cottonseed oil produced, about 2.33 tons of cake are also produced as a joint

product; in the case of soya bean oil, the joint product of cake is about 7.2 tons. Because of a superabundance of cake and other competing feeds, the price of cake in the United States is low. Indeed, there is a surplus for export. Hence, the relatively small percentage of oil and the low price of cake afford little inducement to the growing of soya beans for oil.

5. Subordinate Character of Domestic Oil Industries

All of the domestic oils and fats are by-products or at best joint products. The part of the domestic corn crop that goes into oil is almost negligible. It is a by-product of a by-product. The value of seed resulting from cotton growing is small compared with that of the fiber. The situation with respect to peanut growing has already been stated. In considering the acreage to be devoted to a crop the farmer is moved by consideration affecting the principal product rather than the by-product. A small change in the price of oil could have little effect in expanding the growing of the crop from which the seed is derived.

Studied oil by oil it would appear that there was little to justify the proponents of a duty on Philippine coconut oil in either of their contentions; it would not appreciably aid the dairymen by improving the price of butter, nor agriculture in general by affording a greater diversity of crops to the farmer.

FORECASTING THE YIELD OF WINTER WHEAT SEVEN MONTHS PRIOR TO HARVEST[1]

HOMER J. HENNEY
KANSAS AGRICULTURAL EXPERIMENT STATION

Introduction

Since supply is such an important factor in determining the price of wheat, there is need of knowing more about the future supply of wheat as far in advance of harvest as possible.

This study involves only a section of Kansas comprising 14 of the largest wheat producing counties of the state. Only this one section was included, as an estimate for the state would involve extending the study to include all of the nine crop reporting districts.[2]

Studies by the writer indicate that winter wheat yields tend to be influenced more by the rainfall previous to seeding time and by the soil moisture present at seeding time than by rainfall which occurs after seeding. Consequently additional information was sought on just how conditions during the previous year or two affected the yield.

Both temperature and rainfall have always been considered important in determining the yield of most agricultural crops, especially wheat.

It is not the purpose of this paper to convey the idea that some new method of forecasting wheat production has been developed but to open up the field for a critical discussion by economists, agronomists, and statisticians. The study is only suggestive of the possibilities of such an attack and the author hopes that criticism will develop new studies which will show a higher correlation and a smaller standard error of estimate than are shown with this particular study.

Recent studies (5 and 9)[3] on the relation between weather and the yields of various crops prompted the author to attack the problem of estimating Kansas wheat production by a different method from that followed in most other studies. The principal difference between this study and most of the others is that temperature and relative humidity are omitted. Also, the period of

---

[1] Contribution No. 70, Department of Agricultural Economics, Kansas Agricultural Experiment Station.

[2] The crop reporting districts as established by the Division of Crop and Livestock Estimates, Bureau of Agricultural Economics, Washington, D.C.

[3] (All numerals in parentheses refer to literature cited on the last page.) Many of the references cited were suggested by Dr. John H. Parker, Plant Breeder, Kansas Agricultural Experiment Station, and appreciation is due him for his constructive criticism of the paper.

weather which is assumed to be important in determining the production is divided into several sub-periods and each sub-period is used as an independent factor in the statistical determination of the relationships. For example, the precipitation for the period from July to November was used in most of the studies, not as one independent factor X_1, but as three independent factors; July and August precipitation as X_1, September and October precipitation as X_2, and November precipitation as X_3. In addition to using precipitation in inches for these months as separate factors, the relationship between one period and the subsequent period was sometimes used as a separate and independent factor to explain variation in production from the normal secular trend of production. For example, the total precipitation for two periods, of four months each, might be the same but in one case the precipitation falling the last one-half of the period may be 50 per cent of the total and in another it may be 85 per cent of the total. Aside from these diversions, the study has followed, for the most part, the procedure used in previous studies.

Review of Previous Studies

Most of the published material relative to estimates of crop yields have taken into account both temperature and precipitation. The studies more closely related to wheat have centered around soil moisture and water used by spring planted crops (4 and 7). The studies dealing with the perennials, such as alfalfa, rather than with the annuals, such as cotton (9), corn (10), and spring wheat (8) have been of the most help in securing the evidence on which the conclusions from this study are based. Burr (3) made studies showing that continuous alfalfa depleted the soil moisture in the lower 12 to 25 feet of the soil to such a degree that it probably would never be resupplied. His studies indicate that the reduction in the yield of alfalfa after three to four years of cropping is due to a deficiency of subsoil moisture which cannot be replaced in one or two years of spring crops or fallow. The studies of Harris and Scofield (6) indicate that a crop can affect the subsequent crops for two or three years because of depletion of the reserve moisture.

The most recent study of importance is by Halstead and Coles (5). They show a high relation between the soil moisture at the time for seeding winter wheat and the yield of wheat. Their studies deal with the moisture in the upper three feet of soil at seeding time under various methods of culture. With continu-

ous wheat on early listed ground, they show a correlation coefficient between soil moisture and yield of +.8268 ±.0533. The correlation coefficient for the same factors for continuous wheat on late plowing is among the highest relationships shown, +.8523 ±.0447. The fallow plots had the highest moisture content at seeding and showed the lowest correlations of all methods. This would indicate that if the better methods of seed bed preparation are being practiced by more farmers each year the relationship between soil moisture readings and production is apt to decrease rather than increase. The lower correlation shown by early preparation, especially fallow, than is shown by late preparation is probably due to more nutrients made available for plant growth by the precipitation retained from spring rains previous to fall sowing. This also tends to show the effect of a crop or no crop on the subsequent crop.

Cole and Mathews' (4) conclusion was that the high correlation of the total water used with the portion obtained from reduction of the soil water content indicates that under the conditions specified for spring wheat studies the stored water is a more dependable source of supply than the current precipitation. The main conclusion to be drawn from their paper is that soil moisture can never be great enough to carry a crop of spring wheat through without some decrease from normal yield if the spring precipitation is considerably below its normal.

If precipitation 12 to 18 months previous to harvest affects the supply of moisture available for the crop it must be stored in some form previous to the seeding date for that crop. Mathews (5) indicates that the plants quite often use the stored moisture to a depth of four feet. He states that seldom can precipitation from one harvest to another build up the previously depleted moisture in the subsoil below the fourth foot. This must be done by copious rains for a period longer than twelve months. In years when the crop uses moisture from only the upper two feet because of heavy spring rainfall the third and fourth feet are left with a more than normal reserve for the subsequent crop. In years when the growing crop uses heavily from the fourth foot, the moisture in this fourth foot, would seldom be restored to its normal water carrying capacity within a twelve month period.

Procedure

The first studies dealt with the total rainfall and the average yield per acre of wheat in Kansas. This was followed by a sep-

aration of rainfall into the fall period before seeding, the fall months after seeding and the spring period preceding harvest. The next step was to use both fall and spring rainfall separately with total production in Kansas rather than yield per acre. As great an increase in the correlation coefficient occurred when this change was made as has occurred with any other change in the method of procedure. The study revealed that probably the eastern one-third of Kansas, where precipitation was heavy and total production small, was causing the greatest error. To reduce this error the procedure was modified from that of using total Kansas rainfall and total production of wheat to that of using the precipitation and production in one county[4] only. Ellis county was used, since the Hays Experiment Station is located there. There was little improvement by using the smaller areas until the fall period of the year previous to harvest was subdivided into two or more periods. The precipitation in the spring previous to harvest was used as a second factor but failed to bring the estimates closer to the actual yields and in most cases gave a lower index of relationship[5] when it was included. Because of the greater error by adding the spring precipitation previous to harvest, it was decided to use the spring precipitation of the previous year. It was this step that increased the correlation almost as much as did the shifting of the dependent factor from a yield per acre harvested basis to a total production from a given area basis. It was suggested[6] then that larger than county units be used. The larger than county areas revealed the practical value of using precipitation in forecasting the supply of wheat for Kansas. The counties used[7] were fairly well scattered over the two crop reporting districts, the production in these 14 counties was correlated with the precipitation by months in the middle division of Kansas. This particular relationship is the one shown in this study.

---

[4] At the suggestion of S. C. Salmon, formerly Professor of Farm Crops, Kansas State College, the study proceeded by using counties as a unit.

[5] The index of relationship referred to in this paper is the index of correlation or the same expression for curvilinear relation as a correlation coefficient is for linear relationships. Since the relation is curvilinear and so expressed by free hand regression curves, the word index or correlation is used instead of coefficient of correlation. See *Method of Correlation Analysis*, by Mordecai Ezekiel, page 119.

[6] J. A. Hodges of the Department of Agricultural Economics, Kansas Agricultural Experiment Station, suggested a unit of four to eight counties rather than county units or state units. This suggestion was prompted because of relationship studies which Mr. Hodges has made of precipitation and temperature to corn yields in each type of farming area in Kansas.

[7] The following counties were used for production: Barton, Ellis, Rush, Rice, McPherson, Russell, Barber, Comanche, Harper, Kingman, Pratt, Reno, Sumner, and Stafford. The normal trend production for these counties is about 45 million bushels or almost one-third of a normal trend Kansas crop. The normal production for the central and south central section of Kansas is about 75 million bushels or about one-half of a normal trend Kansas winter wheat crop.

Sources of Data and Methods

As previously stated, the precipitation was the monthly average in inches as given by the United States Weather Bureau for the middle division of Kansas. Only data since 1914 were used as prior to that time county records on rainfall which make up the middle division monthly averages are none too complete. All production data are used in per cent of a secular trend normal production. The estimates as read are a certain per cent of a normal production rather than millions of bushels. The first studies were made by partial and multiple correlation procedure using the product-moment method for ungrouped data. In the later studies the method of graphic curvilinear correlation was used.[8] The fall precipitation is used as it is given in inches. The spring rainfall one year previous to harvest is used as an index of the moisture used by the crop maturing in that year.

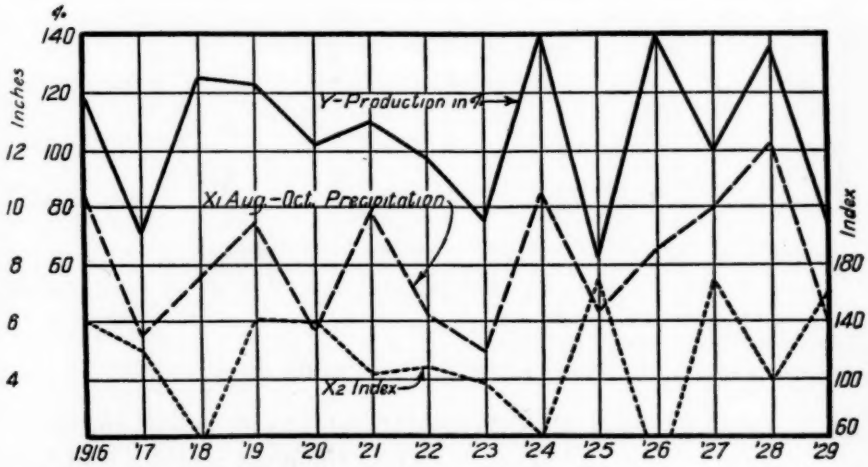


FIGURE 1.—The three factors used in the study:

———— Y Production of winter wheat in per cent of normal trend.

- - - - - - - - X_1 Inches of fall precipitation, August, September, October at the time of planting.

..... X_2 Index of spring precipitation (March, April, May, June) used one year previous to harvest.

Table I shows the original data in columns 1, 2, and 5. The first estimates of production by using the first factor are given in column 3 and the final estimates by using both factors are given in column 7.

---

[8] Applications of a simplified method of graphic curvilinear correlation by L. H. Bean, mimeographed report, Bureau of Agricultural Economics, United States Department of Agriculture. The author is indebted to Mr. Bean for the suggestions he has given for ways of detecting independent factors, which probably would never have been discovered by the formal statistical method or by the free hand method without his suggestions.

Analysis and Discussion

Figure 1 shows graphically the three factors used: Y as the dependent factor, is the production of wheat in the 14 counties expressed as per cent of normal secular trend production; X_1 as the first independent factor, is the total precipitation in inches during August, September, and October, of the fall when the crop is planted; and X_2 as the second independent factor, is the

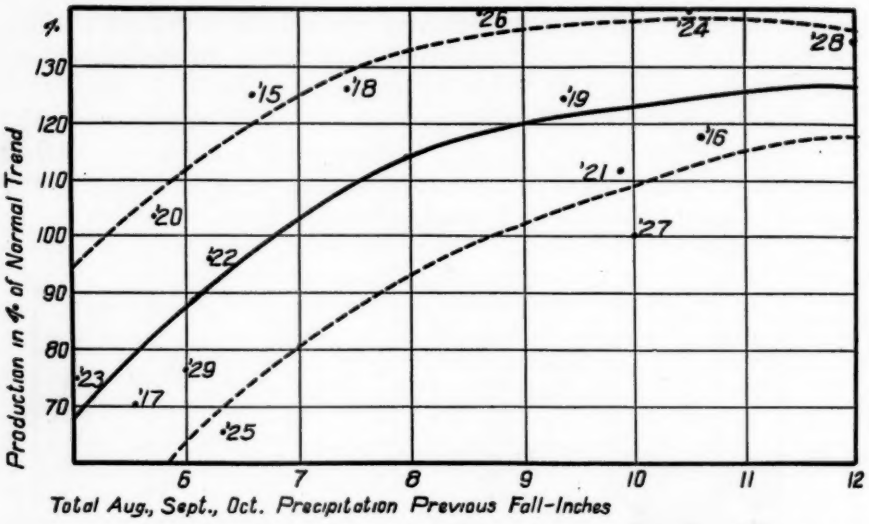


FIGURE 2.—Relation between production and the total August, September, October precipitation previous to harvest.

———— Estimating curve.

- - - - - - - - Relation of major differences to the curve.

total spring precipitation during March, April, May, and June one year previous to harvest used by the crop maturing in that year in terms of a constructed index.[9]

The purpose of figure 1 is to show the wide fluctuation in each factor from one year to another as well as the direct relation of production to the August-October rainfall and the inverse relation of production to the spring moisture used one year previous to harvest.

Graphic curvilinear correlation was the method used in arriving at the estimating lines in figures 2 and 4. The index of cor-

[9] The index is made up by dividing the per cent that precipitation was of normal by the per cent that the growing crop at that time was of normal. If the precipitation was —20 per cent of normal and the crop harvested was —20 per cent of normal, then 20 per cent ÷ 20 per cent = 100 per cent, or a normal proportion of the precipitation was used by the previous crop and a normal proportion was left for the subsequent crop.

TABLE I.—DATA USED IN FIGURES 1 TO 6

	Col. 1 Y	Col. 2 X_1	Col. 3 E_1	Col. 4 D_1	Col. 5 X_2	Col. 6 ED_1	Col. 7 E_2	Col. 8 D_2
	Actual production per cent of normal	Aug.-Oct. precipitation previous fall	Estimated production by curve in fig. 2	Difference actual varies from first estimate	Index of spring moisture used one year previous	Estimate of first difference by curve in fig. 4	Final estimate per cent of normal	Difference actual varies from final estimate
	(per cent)	(inches)	(per cent)	(per cent)	(inches)			(per cent)
1916	117	10.53	122	− 5	140	−4	118	− 1
1917	70	5.51	77	− 7	122	+ 2	80	− 9
1918	126	7.45	111	+15	55	+18	129	− 3
1919	124	9.35	120	+ 4	141	− 3	117	+ 7
1920	104	5.73	83	+21	139	− 4	79	+25(a)
1921	111	9.86	121	−10	104	+ 7	128	−17(a)
1922	96	6.22	91	+ 5	111	+ 7	98	− 2
1923	75	4.97	65	+10	96	+11	76	− 1
1924	140	10.47	122	+18	60	+15	137	+ 3
1925	63	6.34	95	−32	170	−26	69	− 6
1926	140	8.64	118	+22	33	+19	137	+ 3
1927	100	9.95	121	−21	170	−28	93	+ 7
1928	134	12.26	125	+ 9	100	+10	135	− 1
1929	76	6.00	87	−11	164	−18	69	+ 7
Total				190				95
Ave.				13.6				6.78

Y—Dependent factor.
X_1—First independent factor.
X_2—Second independent factor.
E_1—Estimated from effect of X_1.
E_2—Estimated from effect of X_1 and X_2.

D_1—Difference between actual and estimate when X_1 is used.
ED_1—Estimate first difference from effect of X_2.
D_2—Difference between actual and estimate when X_1 and X_2 are used.

(a) See page 327.

relation was obtained by a simple relationship between the actual production (column 1) and estimated production (column 7). The standard error of estimate is the standard deviation of the differences (column 8) between the actual production (column 1) and the final estimates of production (column 7). The production estimated by the free hand estimating curve of figure 2 is shown in Table 1, column 3. Figure 2 shows the years that production varied greatly from what the fall moisture would have indicated.

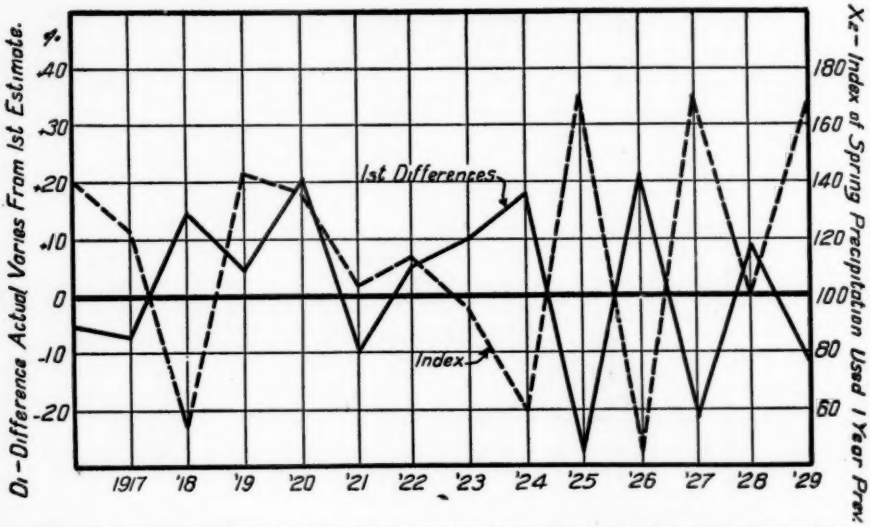


FIGURE 3.—The difference the actual varies from the first estimate and the index of spring precipitation used one year previous to harvest.

The dotted lines are shown to justify a curve rather than a straight line for the first estimating line. The difference between the actual production and the estimated production is given in Table I, Column 4. The next step is to find some factor that is related to these differences or the differences that are not explained by X_1, which is the August-October precipitation of the previous fall. To locate this factor the differences are shown graphically in time series in figure 3.

Any factor which tends to coincide with the differences would have a positive relation with production. Any factor as X_2 which tends to have the reverse trend each year would have a negative relation with production. By referring to figure 1, it is clear that X_1 has a positive relation and X_2 has a negative relation with production. The next step was to make a scatter diagram showing the relation between the factor showing the highest relation to

the first differences, D_1 of Table I, column 4. Figure 4 shows this relation and the second free hand estimating curve.

From this curve are read the estimates of the first differences as given in column 6, Table 1. The differences between the estimates of the first differences and the actual differences of col-

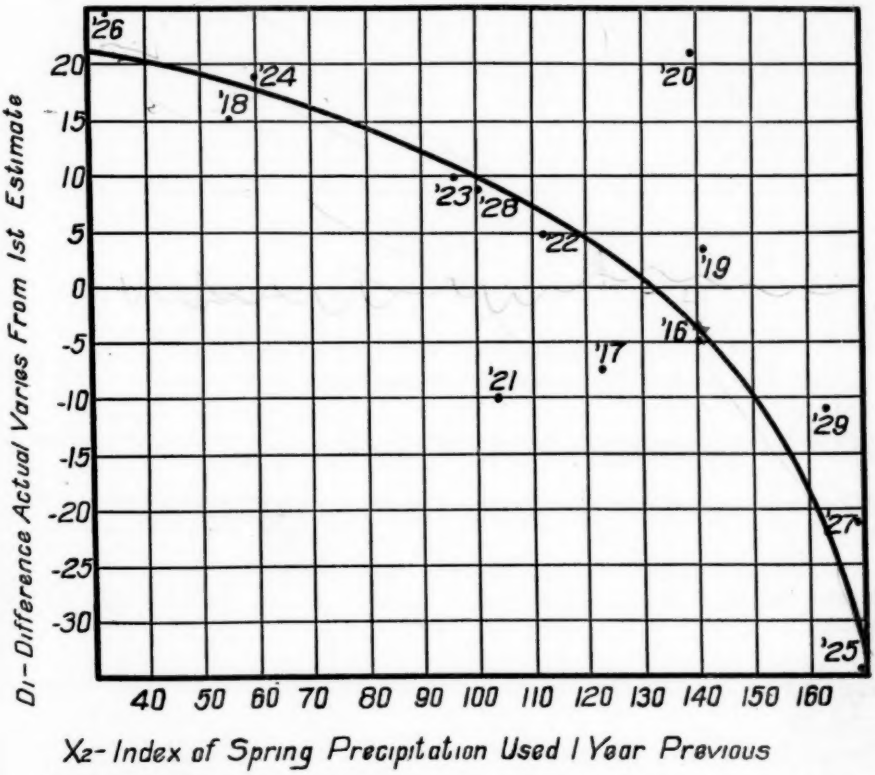


FIGURE 4.—The relation between D_1—Difference actual varies from first estimate and X_2, index of spring precipitation used one year previous.

umn 4, Table 1, are the final differences not explained by the combined effect of X_1 and X_2. The final estimates of production in per cent of normal are obtained by subtracting these final differences, D_2 in column 8, Table 1, algebraically from the actual production, Y in column 1, Table 1.

Final Results

Figure 5 shows the closeness of the estimate for the period 1917 to 1929. Only two years, 1920 and 1921, are greatly in error.

Statistical explanations for the large errors in those two years

failed when temperature and rainfall data in the spring were used. It appears that radical price advances for two years should have been responsible for a shift in acreage to the better or poorer areas and at the same time brought about better or poorer methods of seed bed preparation. Such changes are observed in the planting of most crops when the price of the commodity advances or declines rapidly. To tie such factors up statistically so as to give a higher correlation for this study is as yet beyond the ability of the author.

Alsberg and Griffing (1), quote Hooker as saying that all other

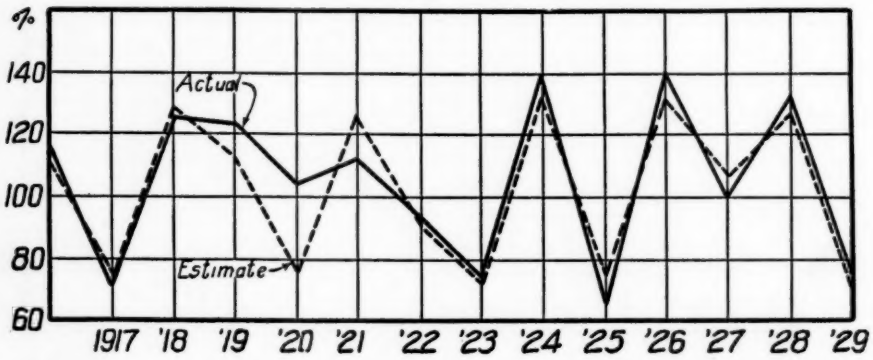


FIGURE 5.—The actual wheat production in 14 counties of central and south central Kansas and the estimated production from important factors, in per cent of normal trend.

factors such as sunshine, hail, humidity, electrical storms, insect and fungoid attacks are probably of minor importance in accounting for differences not accounted for by rainfall.

The next step was to determine the importance of each factor X_1 and X_2 by correlating the actual production in column 1 with both the first estimate, column 3, and the final estimate column 7. The index of correlation between the actual Y and the fall precipitation X_1 was $+.7914 \pm .0673$. The index of correlation between the actual Y and the final estimate using the combined effect of X_1 and X_2 was $+.9275 \pm .0252$. An index of correlation of $+.9275$ means that 86 per cent of the variance in the dependent factor, production, is associated with the two factors X_1 and X_2. This relation is high enough to be significant and of prediction value, especially when it can be obtained seven months previous to harvest.

The standard error of estimate which is the standard devia-

tion of the final differences is 9.35 per cent; which means that two times out of three the estimated production will agree with the actual production to within the limit of 9.35 per cent of a normal production. The same type of study for each of the 9 districts of Kansas applied to a Kansas crop of a normal trend production of 150 million bushels, would mean that the actual production would be within the limits, 136 million and 164 million bushels, two-thirds of the time. The modal error is less than seven per cent as 11 of the 14 errors are less than eight per cent. When applied to a Kansas crop of 150 million bushels on this basis, one would expect an error of not more than eight million bushels two-thirds of the time.

Summary

1. In areas where wheat acreage comprises more than three-fourths of the cultivated land and diversification is not greatly practiced, there tend to be alternating years of high and low yields. In areas where wheat acreage is less than one-half the acreage in cultivated crops, there is much higher relation between the late fall rains and yield than in any other type of farming. Following years of large corn, kafir, and wheat yields, in diversified areas there tends to be a smaller yield of wheat than fall rainfall would indicate. All this tends to verify the opinion of the farmer that after a year or two of crop failure, it is about time for a bumper crop.

2. Other studies show that it is very likely that each crop reporting district in Kansas will need to have its own individual estimating equations in order to be of practical forecasting value. The differences in soil types, variation in temperature, length of season for bacterial action, proportion of cultivated area used for other crops, and the seasonal distribution of rainfall probably represent some of the reasons for the same formulae not being applicable to all of the nine crop reporting districts in Kansas.

3. The fact that precipitation can account for so much of the variation in total production indicates that winter killing and other limiting factors play only minor rôles unless accompanied by a deficiency of rainfall.

4. July rainfall preceding sowing is probably more important in recent years since improved methods of early seedbed preparation are in more general use.

5. Rainfall for a month or two before and after seeding of win-

ter wheat in Kansas, combined with spring precipitation one year previous to harvest apparently has more influence on production than precipitation in the spring just previous to harvest.

Literature Cited

1. Alsberg, C. L. and Griffing, E. P. "Forecasting wheat yields from the weather." *Food Research Institute, Wheat Studies,* Vol. 5, No. 1, 1928.
2. Bogue, A. H. "The relationship between the yield of wheat in the prairie provinces and the weather." *Agricultural Statistics,* Dominion Bureau of Statistics, Canada, Vol. 23: 312-317. 1930.
3. Burr, W. W. "Soil moisture studies." *Bulletin 5,* Neb. Agr. Exp. Sta., 1914.
4. Cole, John S. and Mathews, O. R. "Use of water by spring wheat on the Great Plains." *U.S.D.A. Bul. 1004,* 1923.
5. Halstead, A. L., and Coles, E. H. "A preliminary report of the relation between yield of winter wheat and moisture in the soil at seeding time." *Jour. of Agr. Res.,* 41: 467-477, 1930.
6. Harris, J. Arthur and Scofield, C. S. "Permanence of differences in the plots of an experimental field." *Jour. Agr. Res.,* 20: 335-356. 1920.
7. Mathews, O. R. "Predicting wheat yields of spring wheat in the Great Plains." *Jour. Am. Soc. Agron.,* 17: 89-90. 1925.
   "Storage of water in soil and its utilization by spring wheat." *U.S.D.A. Bul. 1139,* 1923.
8. Shantz, H. L. "Water requirements of plants at Akron, Colorado." *Jour. of Agr. Res.,* 34: 1093-1190. 1927.
9. Smith, B. B. "Relation between weather conditions and yield of cotton in Louisiana." *Jour. Agr. Res.,* 30: 1083-1086. 1925.
10. Wallace, H. A. "Mathematical inquiry into the effect of weather on corn yield in the eight corn belt states." *Monthly Weather Review,* Vol. 48, No. 8, pp. 439-445. 1920.

TRENDS IN MACHINERY COST AND WAGES PAID TO FARM LABOR

C. M. PURVES
BUREAU OF AGRICULTURAL ECONOMICS

The cost of machinery and wages paid to hired labor are two of the most important costs entering into agricultural production. During the past ten years, prices of farm machinery and farm wages both have been relatively high in comparison to prices of most other commodities used in production and also high in comparison with prices received for farm products. Figure I shows the comparison of the index numbers of farm ma-

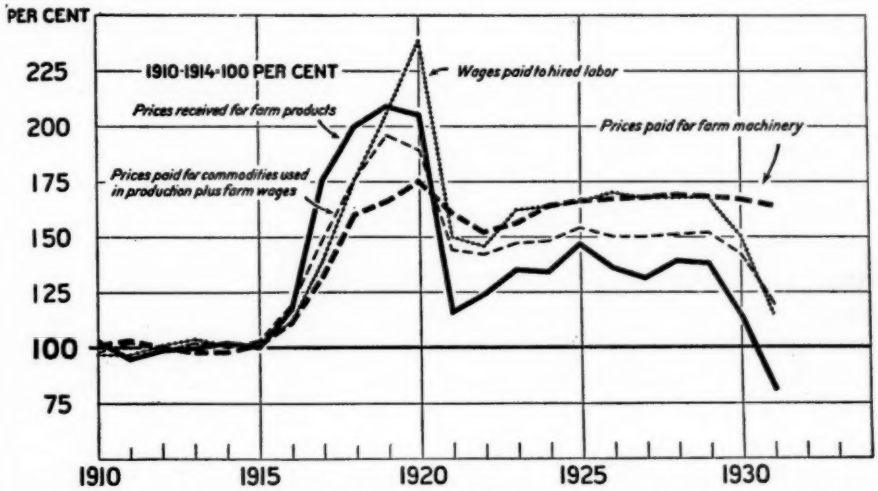


FIGURE 1.—Prices received for farm products and prices paid by farmers for commodities.

The decline in farm machinery prices in 1920 and 1921 was less marked than for most other commodities. From 1924 prices tended gradually upward until 1928, and have as yet shown little tendency to decline.

chinery prices and farm wages with the index numbers of all commodities entering into production combined with farm wages and the index numbers of prices received for farm products. The high prices of machinery and high level of wages have been the principal factors in keeping the production index above the index of farm products since 1921.

The comparisons on the above chart show that from 1917 to 1920 the index of farm machinery prices was lower than any of the other indexes. These relatively cheap prices for farm ma-

chinery resulted in farmers buying a large amount of equipment during this period, especially tractors and tractor-drawn equipment, and marks the beginning of the trend toward the use of mechanical power. More tractors were sold to farmers in 1919 than in any other year to date.

The decline in farm machinery prices in 1920 and 1921 was less marked than for most other commodities and prices soon rose again to only slightly below the price level of 1919. From 1924 prices tended gradually upward until 1928, when the index of farm machinery prices reached 169, or within 6 points of the peak of machinery prices, in 1919. Prices of farm machinery in general have as yet shown little tendency to decline materially. The index of machinery prices was 164 on June 15, 1931, or only 5 points below the level of 1928. Since the principal item of cost in the production of machinery is labor, no marked decline in machinery prices can take place without a material reduction in wage rates.

Farm wages, on the other hand, advanced rapidly from 1917 to 1920, due to the shortage of labor, and in 1920 wages were unusually high in comparison with the other groups of commodities. There was, however, a sharp drop in the index of wages in 1921, and labor became relatively cheaper than machinery. After remaining low through 1922, wages advanced sharply in 1923, and up to 1929 remained at high levels. The index of farm wages has declined continuously since June, 1929, and on January 1, 1932, was 2 per cent below the pre-war level. From 1923 to 1929 the index of wages to hired labor and index of prices paid for farm machinery were at approximately the same levels, but by the end of 1931 the index of farm wages was only about two-thirds that of farm machinery.

The increase in the use of mechanical power on farms since 1917 has resulted in a drastic decline in the purchases of horse-drawn equipment. In the years 1925-29 the production of farm wagons averaged only 15 per cent of the 1909 and 1914 average production. The production of hay rakes was only 31 per cent of the earlier years; of mowers, 37 per cent; of grain binders, 38 per cent; of 2-bottom plows and disk harrows, 40 per cent; of walking plows, 41 per cent; of 2-row corn planters, 55 per cent; and of grain drills, 62 per cent. Since the farm machinery industry is one of decreasing costs as output increases, this sharp falling off in production has resulted in increased costs per unit, and has tended to keep the price of horse-drawn equipment

relatively higher than the general level of all farm machinery prices. On June 15, 1931, the index of farm machinery prices was 164, but the price of farm wagons to farmers was 182 per cent of the 1910-14 price. Walking plows were about twice as high as in pre-war years, and 2-bottom horse-drawn plows were about 170 per cent of the earlier period. Prices of tractors, tractor-drawn equipment, and other mechanical power machinery have declined as they have come into general use, but most of these implements were not introduced until after 1919. Prices are available from 1913 to date for only three mechanical power machines; tractors, gas engines, and tractor-drawn plows. In 1931, wholesale prices of tractors were 56 per cent of 1913; of gas engines, 90 per cent; and of tractor-drawn plows, 107 per cent.

The level of farm wages is determined largely by the level of wages in industry and by business conditions. Every major depression has resulted in a movement of labor to the farming areas. Major depressions also usually result in sharp price declines for farm products, making it necessary for farmers to economize by using as little hired labor as possible. These two factors result in a large supply of farm labor with little demand for it, and as a result farm wages decline sharply. When business activity begins to increase, employment conditions improve and farm prices usually advance, thus curtailing the amount of farm labor available and increasing the demand for it. These conditions result in marked fluctuations in the level of farm wages during the course of a major business cycle.

The price changes in farm products, in farm wages, and in machinery during the past two years have resulted in a shift toward the greater use of horse-drawn equipment. Reports from general-farming areas are that more farm work was done by horses in 1931 than for several years. The past season was favorable for farm work and many farmers did their plowing with horses, although they owned tractors. As long as feed prices and farm wages remain relatively low, this shift toward the increasing use of horses may be expected to continue, but may be limited by the continued decline in the number of horses available. No doubt some of this shift back to the use of horses is due to the lack of credit on the part of many farmers to buy fuel, repairs, and replacements for their tractors, but in many cases it is due to farmers' having analyzed their production costs and having determined to get the work done as cheaply as possible. Many

farmers feel that the present low prices of farm products are due to the increased use of mechanical power and that it has been a curse to them instead of a blessing. No doubt this has been a contributing factor toward lower prices since the replacement of horses by tractors has made it possible to divert several million acres of farm lands to the raising of cash crops instead of feed crops, thus increasing the supply of cash crops and decreasing the demand for feed crops for horses. The greater use of horses has made it possible for farmers to curtail their cash outlay, which is an important consideration in times of low money incomes.

The present condition and supplies of farm machinery and farm power and the trend of agricultural production will have a material influence on the trend of machinery sales in the next decade. The total area devoted to crops has increased very little during the past few years, and the present low prices of farm products offers little incentive for further expansion of crop land. This means that practically the only market for farm machinery in the United States is for replacements rather than for the development of new areas. No doubt, this slowing up of new land entering production has been partly responsible for the marked decline in the sales of many of the different articles of machinery during the past twenty years. Low prices of farm products is retarding these replacements until farmers are in a financial position to buy machinery or until they see an opportunity to buy new machines and make them pay for themselves in a short time. When farmers had to pay 10 to 12 cents to get corn picked, corn pickers paid for themselves in a few years, but in 1931 when farmers could get corn picked for 3 and 4 cents a bushel, it was less expensive to get the corn husked by hand. When farm prices are low, farmers try to get along with the old machines, but in periods of high prices it is profitable to pay high prices for machinery. For this reason the demand for farm machinery changes rapidly with the price of agricultural products and little increase in farm machinery sales can be stimulated by cutting prices in periods of depression.

The marked decline in the number of horses during the past ten years and the high average age of horses now on farms may mean an acute shortage of horses in the next few years, especially if the tendency to do a larger proportion of the farm work with horses continues. Since the number of suitable breeding animals now on farms is greatly reduced, the maximum number

of colts that could be raised from this breeding stock, during the next ten years, could not prevent the number of horses and mules from declining below present levels.

Since 1924 there has been a downward trend in the price level of non-agricultural products. In contrast, the trend of industrial wages from 1924 to 1929 was upward. The effect of these opposite trends has been to replace labor with machinery wherever possible. During the years 1928 and 1929, when business activity was at a high level, this replacement of labor by machinery was not so apparent, but as business activity began to decline, the surplus of labor began to increase and unemployment has now become a very serious problem. The degree to which this unemployment problem will be alleviated depends to a large extent upon the rapidity with which business returns to normal levels and the readjustments that take place in wage rates.

In conclusion, it appears that for the present at least the increasing use of mechanical power has been interrupted by the low level of feed prices, farm wages, and lack of credit on the part of farmers generally to purchase tractor fuel, replacements, and repairs.

The future trend of business activity, agricultural prices, and wage rates in cities will have an important bearing on supply of and demand for farm labor and consequently on the trend of farm wages. An advance in the prices for feed crops, horses, and labor would increase the possibilities for the use of mechanical power equipment. On the other hand, the present low level of feed prices, cheap horses, and lower level of wages favors the increasing use of horse-drawn equipment in many areas, but declining horse numbers is a limiting factor in this "back to the horse" movement. The sales of horse-drawn equipment during the past few years have been low and the market for such machinery is largely for replacement only. Higher per unit costs because of low output of farm machinery and the high level of industrial wages are a limiting factor in the reduction of farm machinery prices.

EXPERIMENTS IN THE USE OF LARGE-SCALE MACHINERY UNDER MONTANA CONDITIONS

E. A. STARCH
UNIVERSITY OF MONTANA

Farm organization has been influenced constantly and in varying degrees by advances in the fields of biology, chemistry, engineering, and many others. The impact of engineering upon agriculture during the decade has been most far-reaching, if not revolutionary. It is exerting a pressure which is making itself felt in the realignment of the input factors, the size of farm, the technique of production, and even the kind of commodities which are produced on particular farms.

The effect of the recent changes has been felt in the production of practically all commodities, especially wheat, cotton, corn, and hay. In wheat the introduction of the medium-sized tractor and the harvester-thresher has reduced the time required to produce an acre from 8.8 hours of man labor to 2.5 hours, and in the instance of the most modernized farms the labor required has been decreased to three-fourths of an hour. The costs have been constantly lowered until the best organized farms can produce for less than 50 per cent of what it cost only six years ago.

The Mississippi Delta Experiment Station at Stoneville, Mississippi, finds a variation of $9 per acre in the cost of labor, power, and machinery, with the highest cost of $14.20 prevailing where one-mule, one-half row equipment is used and a reduction to $5.20 per acre where four-row power equipment is used. Changes in harvesting and processing cotton are under way.

Also the versatile general-purpose tractor with its complement equipment—three and four-row planters and cultivators, two-row pickers, mowers and rakes—tend to produce new competitive levels and to require the reorganization of farms for the production of corn and hay.

These changes are probably only the primary stages of a long program of farm reorganization due to the infusion of engineering development. This development may be only in its beginning. We are just now in a transition period in designing power equipment for the farm, for up to this time it has been largely a matter of adapting horse-drawn implements to be drawn by a new kind of power. However, if implements for doing farm work are designed henceforth with the new power

plant as a basis, then we may expect revolutionary changes in the type of equipment which will be used in the future. Already such new and radically different types are developing in the minds and upon the drafting boards of the engineers. For instance, the hitches which are now an intermediary link between the power and the working tool may become the chassis for the various kinds of tools necessary upon a particular type of farm. The drills, the cultivators, etc., may become interchangeable on this frame.

A new alloy of metal which has the tensile strength of steel but weighs only one-fourth as much has recently been made available. In agricultural tools, weight is a limiting factor since it must be moved over the land to do its work, therefore, lighter weights mean lower costs and probably an extension of the use of machinery.

An increasingly large portion of the farm operating cost centers around the equipment operation, namely, the depreciation, interest on equipment investment, fuel, oil, and repair costs. These items now constitute 40 per cent of the operating cost on Montana wheat farms, while the labor costs have gone down to 10 per cent of the operating cost. The other 50 per cent of the costs consists of rent, overhead, seed, insurance, and hauling. With the growing importance of the mechanical phase, the efficient use of equipment will measure efficient farm operation to that extent.

Farm organization has three avenues which it may pursue:

1. Adaptation of the land unit to the optimum equipment combination. By this we mean that equipment will lead the way, and when a type and size has been developed which will yield the maximum productivity, it will become the pivot in farm organization and the land unit will be adapted to it.

2. The adaptation of the equipment to the size of the farm unit which now exists. In this case the machinery units would necessarily be smaller than it now seems economic. The power under control of each worker would be small and his output would be proportionate, with probably not sufficient economic advantage to warrant the shift of capital to machines.

3. Machines may be used eventually to reduce the labor and drudgery of the farm family thus releasing their time for other activities of life. There have also been some suggestions of cooperative ownership of equipment for field work which would enable one man to till the fields of several farms, thus allowing

the remaining operators to devote more of their energies to livestock production.

In the Great Plains area, where land units are less fixed than in older sections of the country, the tendency has been very decidedly in the direction of shaping the land unit to the equipment unit. A survey of 100 leading farms showed a 106 per cent increase of tilled acres in five-years time.

In order to ascertain the optimum combinations of land and equipment, the Montana Experiment Station initiated farm organization tests in 1927 where the problems could be studied under actual farm conditions and yet the conditions could be controlled so that the various factors could be studied separately. Experiments carried on there revealed rather early that for the wheat-producing unit, the minimum practical unit of power was a three-plow tractor with its outfit of equipment and that maximum returns were obtained when it was used on 800 acres of land. This was the point of highest efficiency and variations in either direction caused considerable reduction in the net income. Other sizes of land and power equipment units have their points of highest efficiency and should be combined as nearly in these proportions as possible. A four-plow tractor on 1100 acres of land, a six-plow tractor on 1800 acres, and a 12-plow tractor on 3000 acres, are combinations which result in the lowest cost operations.

The optimum combinations given here are for a particular type of production and the farm organization is based upon the alternate crop and summer-fallow plan. The labor basis is the family, as in each case one man with the given amount of power under his control can effectively cover the acreage and needs only occasional extra help.

Two of the major factors which must be balanced one against the other in arriving at the optimum combination are investment and timeliness. The investment per acre in equipment must be kept as low as possible on the one hand, while on the other the work schedule must permit timely operation, as in most areas there are time limits during which each job may be done, imposed by climatic conditions. For instance, in the semi-arid regions, seeding must be done within 15 to 18 days after spring opens. If it is not done within this time the penalty is a 5-to-7-bushel reduction per acre in the yield of wheat. Consequently, the equipment must be sufficient to do each job within the optimum season to avoid this penalty and yet it must not exceed the re-

quirement if the investment burden per acre is to be kept low. The cost of maladjustment here is quite significant.

An illustration is a wheat grower who has just too much land to be handled by one tractor and invests in a second power unit, consequently both tractors are used to only three-fourths capacity. According to our tests, the reduction of the net income in this case is $600 to $700 annually.

Another phase of the problems involved in the mechanized farm is the efficient execution of individual jobs. Every job may be divided into its component parts such as fuel, oil, depreciation, interest on equipment investment, repairs and labor. Allow me to cite again a specific instance such as the improper coordination of the capacity of the tractor to capacity of the implement is costly. According to tests made at the farm management experiment farm the cost of a job or operation may vary as much as one hundred per cent even with the same man and the same tractor on the same ground, the only difference being a variation in the load which was being drawn.

In seeding, a twelve-foot drill behind a four-plow tractor will seed four acres an hour and the cost will be about 56 cents an acre, while the same tractor pulling 24-feet of drill which is more nearly its capacity will seed eight acres an hour at a cost of 30 cents an acre. The labor, tractor depreciation and interest, oil, and repair costs are constant while the increase in fuel cost is not in proportion to the increase in work done; consequently, with costs nearly constant and only one-half as much work done, the 12-foot drill combined with a four-plow tractor will register nearly a double cost.

Similar results were obtained from tests of other jobs and where the underloading was not nearly so apparent as in the instance cited, however, variations from the optimum combination of power and the implement load are reflected very markedly in the cost of the operation.

In many cases the investment cost per acre increases too greatly to warrant a sufficient spread of each type of machine to provide an optimum load for the power on each job. This is especially true of light draft but high cost implements such as drills and planters. Thus the practice of pulling implements tandem has evolved. Cultivating and seeding can be done at the same time and by hitching the drill behind the cultivator the two operations are combined and the cost kept at the minimum.

Mechanization has a decided effect upon the technique of farming. A great many ways of doing things which have become standard by virtue of long practice become altered to fit the régime of the machine. In the case of wheat, curing in the shock between cutting and threshing was believed essential. With the advent of the combine this curing period is eliminated and has been found unnecessary in the dry regions. In the humid regions the problem of drying the grain after it is threshed is being attacked by engineers in order that the economy of the direct harvesting-threshing methods may be incorporated into the farming technique.

Under Great Plains conditions, where summer fallow is a part of the production scheme, a new system has been introduced for the tillage of the fallow. In previous years plowing has been an essential part of the process. With the advent of the duckfoot cultivators and the one-way disk, it was found that the same yield could be obtained by a new means of cultivation known as surface tillage. This method allows the same equipment to cover four times as many acres per day with the consequent reduction in the cost per acre. The decrease in cost as gained by improved technique has been approximately 50 per cent. Good summer fallow, when done by the plowed system, costs approximately $2.80 per acre, while with the surface cultivation system it costs approximately $1.40.

Another instance might be cited where technique will probably be influenced decidedly by the introduction of new machines. The seeding operation has shown little change during the past years. It is now done in approximately the same manner in which it was done a quarter century ago. A number of machines are now being designed and tried which will cultivate the ground and do the seeding all in one operation. If this can be successfully worked out, the cost of the operation will again be cut appreciably.

When a farm operator can do each job at the minimum cost, combine these jobs into a work schedule which will give him the maximum amount of use of his equipment throughout the year, and can coordinate the mechanical unit and the land unit to the point of highest efficiency, then he will have a farm organization which can function most advantageously in the mechanical era.

RESEARCH IN FARM EQUIPMENT COSTS

W. A. Minor, Jr.
Georgia State College of Agriculture

The equipment used on the cotton farms of the South in the past has been of the simplest type. One of the chief reasons for this has been the cropper system of paying labor, under which the labor on the farm costs the same whether labor saving implements are employed or not. In this system the cropper gets one-half of the crops produced after the cost of fertilizer is deducted. It is therefore seen that if one-half of the crop goes for labor, it matters not whether one man or two does the work so far as the landlord is concerned. Another factor in the situation has been the harvesting of cotton, the principal cash crop of the area. Due to the fact that one man could cultivate as much cotton as a family could harvest, it was desirable to have ample labor for harvesting on the place which could be used when needed.

In the last two decades a number of factors have entered to complicate the situation and make advisable changes in farm organization and management. Among these were invasion of the boll weevil and competition of other areas in cotton production, all of which tended to make profits from cotton production more uncertain than in many years. The more or less uncertainty of profits from cotton forced a greater diversity than had been practiced before, and necessitated the use of more equipment and of a different nature from that formerly used. The scarcity of labor during and immediately after the World War made the use of machinery more important than it had been.

In order to give facts on the cost of farm equipment to be used in reorganizing farms in view of present conditions, studies of farm equipment costs were made in the coastal plain, piedmont plateau, and limestone valley areas of the state. Up to that time practically no information bearing on the subject was available from any source.

The investment in machinery per farm and per acre was known, but no idea of the cost per implement or per acre was obtainable. In order to be of most value, farms with varying amounts of equipment were studied, thereby giving a more complete story of the situation.

Many problems were encountered in securing the data and getting it into usable form. In the first place, no reports of

studies of like nature were available as guides, and a form for securing the data had to be prepared and improved after much trial. It was often the case that several questions had to be asked in order to secure the answer to one simple, direct question because the farmers were not accustomed to thinking along these lines. Much of the equipment was old and nearing the end of usefulness but still serving its purpose. It was rather difficult to arrive at a correct depreciation figure for some of these items, but by taking the original cost, present value, years used, and probable future life into consideration, a reasonably satisfactory set of data was obtained. Other important factors in cost was the days used and acres covered which, in many cases, necessitated making a second visit to the farmer before the data were secured in a usable form. Due to the great variety of implements used on the farms studied, the numbers of many of them were small. This tended to make costs on those particular tools somewhat unreliable. There are some important questions on the cost of equipment which the data secured were not sufficient to answer. There are doubts in the mind of the author whether it will be possible to answer these from data secured by the survey method. To cite two or three of these questions will illustrate sufficiently. What is the reduction in depreciation from proper housing of equipment? How does this cost compare with the cost of housing? There are some who believe that the cost of providing shelter for some implements is more than the saving in other costs; while others believe much of the depreciation and repair costs on all implements can be eliminated by proper housing. The value of time lost by a breakdown of an implement cannot easily be measured. Breakdowns usually occur during the busiest seasons when the implement is most needed and, in part at least, may be avoided by proper attention to lubrication, housing, repairs, etc. It is seen that there are many problems relating to cost of implements on the farm which are yet to be solved.

Much of the data needed on cost of farm implements cannot be secured satisfactorily by the survey method. The depreciation of an implement is distributed over a period of years, and to obtain correct balance between depreciation and repairs will require accurate records kept over the life of the machine. In order to properly evaluate comparative costs such as housing and repairs, it will be necessary to have detailed data under comparable conditions for the period that the machine is used. With implements new to the individual or community, survey

data are of doubtful value, while with the older and more common implements it will be more reliable. On the other hand, accurate cost records on a few implements should be of much value in arriving at dependable cost figures. It is therefore believed that accurate cost records over a period of years on all implements on representative farms are needed for final conclusions.

An analysis of costs reveals that ninety per cent of the total costs for farm machinery on these Georgia farms was made up of three items—depreciation, repairs and interest on investment. Depreciation was by far the largest item, making up a little more than forty-five per cent of the total cost; while repairs amounted to about twenty-five per cent, and interest slightly less than twenty per cent. Housing and lubrication amounted to approximately four per cent each and were followed by taxes amounting to two per cent of the total. The relative importance of these items cannot be measured entirely by comparative cost as it is possible for a slight increase in one to cause marked reduction of cost in some of the larger items. For example, a dollar spent for proper lubrication may save many dollars in repairs and depreciation.

While the relative costs of the various items are of importance in pointing out the places where largest savings might be possible, the cost per acre for work done is of primary importance in the economical operation of a farm. In the coastal plains the average original purchase price of implements per tilled acre was $7.42 and the present value $3.87. Annual cost was $1.51 per acre, made up of 74 cents for depreciation, 31 cents interest on investment, 30 cents for repairs, 7 cents for housing, 6 cents for oil and grease, and 3 cents for taxes. In the piedmont plateau and limestone valleys which were considered together, the investment was $15.54 per tilled acre for original cost, and $7.59 per acre based on present value of the equipment. The annual cost per tilled acre was $3.77 composed of $1.67 depreciation, $1.11 repairs, 61 cents interest, 16 cents oil and grease, 14 cents housing, and 8 cents taxes. It will be noted that the costs per acre are generally higher in the piedmont which is largely due to heavier soils and the presence of rocks causing increased repairs and depreciation and to the fact that most implements were used many more days and over more acres in the coastal plain than in the piedmont. Climate and soils which permit more work days in the coastal plain are partly responsible for this difference, although the size of the farm was probably a factor. It

is evident that the more acres an implement can cover in a given year the lower the cost per acre for the implement. The cost per implement was calculated but is not of enough general interest to be discussed here.

In order to study the effect of tilled acres handled per man on the income of a farm, and to find its relation to available implements and farm organization, the farms were grouped on the basis of acres tilled per man. To illustrate, we may take the ten farms with highest tilled acres per man and the ten with lowest tilled acres per man in the piedmont plateau and limestone valleys. The average acres tilled per man were thirty-nine and fourteen respectively. The men handling largest acres had $450 worth of equipment each with which to work, based on present value, while the group with lowest acres had only $97 worth per man. The annual cost per tilled acre was $4.25 on the farms with large acres per man, and $3.50 on the smaller. It is therefore clear that the difference in man labor much more than offsets this difference in cost of equipment. Labor incomes of $1139 and $235 respectively lend further proof to the advantage of handling larger acreage per man.

When the implements present on these groups of farms are studied, it is found that the farms handling larger acres per man have larger numbers of implements used in producing and harvesting feed crops, for example, grain drills, binders, corn planters, hay presses, etc., as well as a few more tractors and one-row cultivators. In view of this situation, it is then important to know what crops and livestock were used in the farm organization.

The acreage in cotton, corn, hay, small grain, and miscellaneous crops are all found to be greater per man on those farms with highest acres per man. The increases are particularly marked on corn, hay, small grain and miscellaneous crops. Brood sows were ten times as numerous on the farms with highest acres tilled per man, and dairy cows seven times as numerous. While all of these data are given per man, the farms were working an average of 4.8 and 4.4 men respectively.

This led to the conclusion that by utilizing more equipment of the right type, a man can handle more than twice the acres, with corresponding increase in income, by expanding principally in feed crops for sale and to be fed to increased numbers of livestock. It is possible that this is indicative of future trends in the agriculture of the southeastern cotton belt.

LAYOUT AS RELATED TO EFFICIENCY IN THE USE OF LABOR

J. E. McCord
The Pennsylvania State College

Labor has been in the past, and still continues to be, one of the important items in the cost of production on eastern farms.

In order to determine the influence of field layout and building arrangement on the labor required to handle crop and livestock enterprises on the farms of Pennsylvania, a project was started in 1928 on 46 different farms in central and eastern Pennsylvania and data collected for three years.

These farms were visited during the summer and fall of 1928 when, with the aid of a plane table, alidade, chain, and tape, a a detailed farm layout was obtained which included roads, lanes, fences, dimensions, and shape of fields. From this map, by means of a planimeter, the acreage in each field was computed. The location of the principal buildings in respect to the fields, and to each other, was first secured by actual chain measurement. The size of these buildings, as well as the interior dimensions, were checked carefully. In this way the distance from the house to the principal buildings, as well as all interior arrangements, were obtained and the distance traveled by the workers to and from the house to feed and care for the different kinds of livestock could be computed.

Each farmer was furnished with labor sheets and an account book. He agreed to keep a daily record on how his time was spent each day of the year, by enterprises and by operations. In addition to the labor record, each farmer furnished a detailed inventory giving the size of all machines used to perform field operations, crop yields, livestock production, and the receipts and expenses of each individual enterprise on the farm. This has made it possible to determine not only the labor requirements of each enterprise and operation, but also the capital expenditures and income from each. This paper, however, will deal only with the field and building arrangements as they affect efficiency in the use of labor.

Crops

Crops will be considered first. The same crops were not produced on every farm and, moreover, the labor requirements varied somewhat in the different years and on the same farm in

the different years for different fields, depending on climatic factors, yield, size of field, and other factors.

The average hours of man, horse, truck, and tractor labor used on these farms for the principal crops is given in Table 1.

TABLE 1.—AVERAGE AMOUNT OF LABOR FOR DIFFERENT CROPS

	Hours per Acre			
	Man	Horse	Tractor	Truck
Corn (Field	49.36	47.57	4.40	.45
Corn (Silage	37.98	48.40		
Oats	19.71	24.37	1.92	.15
Wheat	20.55	22.52	1.36	.15
Hay	12.23	14.56	.39	.06
Alfalfa	16.01	18.25	1.14	—
Potatoes	104.35	88.11	4.43	3.00
Tobacco	104.05	61.28	2.63	.84

The averages given are for all of the fields tabulated during this three-year period for the various crops. The range for man and horse labor for the several crops was found to be as follows:

TABLE 2.—RANGE IN HOURS PER ACRE FOR DIFFERENT CROPS

Crop	Man	Horse
Corn (Field	27.24–104.00	25.83–106.21
Corn (Silage	22.06–132.06	24.12– 93.84
Oats	13.20– 35.25	11.50– 44.53
Wheat	13.43– 46.83	16.03– 51.00
Hay	6.39– 31.70	6.50– 44.45
Alfalfa	13.20– 45.39	11.27– 41.53
Potatoes	44.23–202.75	42.00–165.67
Tobacco	42.58–172.07	43.15–108.19

It is especially with the ranges and causes of same that we are interested.

The totals for man and horse labor check roughly with studies made in other eastern states for the same crops. Tobacco, of course, required more labor than any of the other crops, and hay the least per acre.

Analyzing these different crops, we studied the time required for each individual operation.

The time spent on plowing for the different crops varied only slightly. It was a little higher for corn than for potatoes or tobacco. The time spent in harrowing, however, was greatest for potatoes. As the various field operations for the different crops are not comparable, these will not be discussed.

Two crops only will be considered in this paper. Wheat and potatoes will be taken up separately and the influence of the different factors on labor efficiency will be considered.

Wheat

For wheat, 145 different fields were studied, the fields being grouped by size and distance from the farmstead.

Over half the fields were found to be less than 10 acres in size, and only 11 of the 145 fields were over 20 acres in size. Two-thirds of all the fields were within 1500 feet of the barn, and only 5 of the fields were over 3000 feet away.

These fields were grouped first according to acreage. Those with an acreage under 10 averaged 20.85 man hours per acre. For those where the acreage fell between 10 and 20 acres the average man hours per acre was 20.34, and for the fields 20 acres and over the average man hours was 19.04. This indicates a saving of 1.81 man hours per acre on fields over 20 acres in size as compared with those under 10 acres.

The fields were next grouped according to distance traveled. Those from 1000 to 1500 feet from the buildings as compared with fields under 500 feet away required 2.92 more man hours and 8.11 additional horse hours per acre.

The 48 fields that were under 10 acres in size and less than 1500 feet from the buildings were grouped for special study. The fields from 1000 to 1500 feet from the buildings as compared with those under 500 feet required 10 per cent more man hours and 15 per cent more horse hours per acre.

Wheat Fields Farmed Without Tractor

Of the 48 wheat fields under 10 acres in size, tractor labor was used on 23, while on 25 only horses were used. These 25 were tabulated separately.

Distance factor: It was found that the fields over 1000 feet away, as compared with those under 1000 feet from the buildings, required 21.91 man hours per acre and 31.66 horse hours per acre, or 4.56 more man hours and 6.39 more horse hours per acre.

Size factor: The smaller fields under 7 acres in size, averaging 4.61 acres, required 20.61 man hours and 29.13 horse hours per acre, or 3.44 more man hours and 2.97 more horse hours per acre than those fields over 12 acres in size, averaging 13.44 acres.

Shape factor: The fields were grouped according to shape, but as most of the fields were fairly regular on the sides, no significant differences were noted.

A number of correlations were run on different factors. The most significant being the one between distance and man labor.

For wheat the correlation between distance and man labor was found to be $r = + .827 \pm .033$. Between total acreage and man hours per acre $r = - .198 \pm .104$. These correlations check with the cross tabulations in that man hours per acre were found to increase as distance increased, and as acreage increased man hours per acre decreased.

Potatoes

A cultivated crop will next be considered; 76 potato fields were studied. They were grouped first according to acreage; those under 5 acres, from 5 to 9.9, 10 to 14.9, and those 15 acres and over. As acreage increased, the man hours increased from 105 per acre for the smaller fields to 111 per acre for fields 15 acres and over. It was found, however, that the larger fields had the larger yields. The yield being 284 bushels per acre in fields over 15 acres compared to 207 bushels per acre in fields under 5 acres in size. Fields running 15 acres or more required .39 man hours per bushel as compared to .51 man hours per bushel on fields under 5 acres in size. The savings per bushel of potatoes being .12 man hours in the larger fields.

The 76 potato fields were grouped according to distance from the buildings. Those fields within 1000 feet of the buildings required 13.2 less man hours per acre than those 1000 to 2000 feet from the buildings, and 27.6 less man hours per acre than those 2000 feet or more away.

The yield was somewhat higher per acre in those fields farthest from the buildings, but when put on a man hour per bushel basis it was found that a bushel of potatoes in fields less than 1000 feet from the buildings required .42 man hours per bushel and for fields over 2000 feet away .44 man hours per bushel.

A number of correlations were run on potatoes:

The correlation between acreage and man hours per acre was found to be $r = + .802 \pm .026$.

The correlation between yield per acre and man hours per acre was $r = .443 \pm .062$.

The correlation between distance and man hours was $r = + .30 \pm .07$.

Also a joint correlation was run in which the influence of distance, acreage and yield per acre on man hours per acre was obtained. This was found to be $x = 111.92 + .058x_2 - 6.62x_3 - .17x_4$ which indicates that as the distance increased from the buildings the man hours per bushel increased, while as size of field

increased and yield per acre increased man labor per bushel decreased.

Livestock

Taking livestock and the influence of building arrangement on the labor requirements, we find that it required the following number of hours per animal unit, as is shown in Table 3.

TABLE 3.—LABOR REQUIREMENTS OF LIVESTOCK

Kind of Livestock	Labor Requirements per Head			
	Man Hours	Horse Hours	Tractor Hours	Truck Hours
Cows	158.81	1.67	3.75	1.75
Horses	101.03	5.32	1.06	.20
Poultry	1.77	.06	.01	.02
Hogs	25.04	.39	.44	.90

It was found that 100 head of poultry required slightly more man hours than 1 cow, and considerably more labor than 1 horse.

The range in labor requirements for livestock was also determined. It was found to be as follows:

TABLE 4.—RANGE IN LABOR REQUIREMENTS OF LIVESTOCK

Kind of Livestock	Range in Labor Requirements	
	Man Hours	Horse Hours
Cows	89.32–292.10	0–39.18
Horses	45.94–195.00	0–39.15
Poultry	.51– 5.18	0–25.66
Hogs	6.77– 59.00	0– 9.54

This range was caused by a number of factors. Tabulations were made to determine the effect of some of these factors.

In this paper only dairy cows will be considered.

The cows were first grouped according to numbers in the herd. The herds under 5 cows, averaging 3 in number, required for care and milking 199.5 man hours, while those herds with from 15 to 19 cows in the herd, averaging 17, required only 142.85 man hours per cow. This represents a saving in man labor per cow of 56.65 man hours, the production per cow being practically the same in the different herds.

The cows were then grouped according to distance traveled per cow. In only a few barns to date has the distance traveled been computed but it was found that in the barns where the interior arrangement was such as to require the most travel per cow, the most man labor was also required and usually the production was lower. In barns where the travel per cow per year averaged 10 miles, the man labor per cow was 138.73, while in

herds which required travel of 20 miles or more per cow, the man labor required was 164.60. The production in the group requiring the most travel was 6500 pounds per cow as compared to 6800 pounds.

Conclusion

This study presents evidence to substantiate previous studies on labor requirements. The material indicates the very great importance of proper arrangement of fields in relation to the buildings and of the proper interior arrangement of such buildings.

This report deals with crops from the standpoints of size of field and distance from buildings. It is felt, however, that many other factors enter in, such as shape of fields, soil, climatic conditions, kind of machinery used, size of machine, as well as time of performing certain operations.

STUDY OF LABOR SAVING METHODS AND TECHNIQUE ON VEGETABLE FARMS IN MASSACHUSETTS

ROLLIN H. BARRETT
MASSACHUSETTS STATE COLLEGE

Labor records obtained during the summer of 1930 from vegetable farmers in eastern Massachusetts showed that many vegetables are produced with relatively high labor inputs. For example, a number of crops on some farms had labor inputs of 1000 to 1500 hours per acre. Financial records from various vegetable farms studied in this area in the same year indicated that on the average 40 to 50 per cent of the total cash expense was for hired labor. Therefore, any economies in labor which can be worked out can be quickly translated into a definite financial saving.

The labor records mentioned above further indicate large differences in the amount of time spent on different farms in performing identical tasks. These differences are due to variations in physical layout, equipment, methods, and technique. Many growers follow a certain routine because of force of habit, because they have never bothered to work out an improved technique, or because more efficient practices already known have never been presented to them in a usable form. Observations of methods in use on nearby farms would often suggest radical changes. For example, two neighboring vegetable farmers in eastern Massachusetts are following two different systems in the simple operation of bunching and tying carrots. Farmer A is able to put up five times as many carrots per hour as farmer B. There is no reason why A's method could not be used by B, thereby eliminating considerable hand labor on this one operation alone.

In addition to the differences in time found in 1930 in performing identical tasks, wide variations in the labor inputs per acre for different vegetables were also noted. For the purpose of this study the vegetables were classified as follows: crops with low labor input, 75 to 125 man hours per acre, such as squash and sweet corn; crops with medium labor input, 150 to 300 man hours per acre, such as cabbage, peppers, and spinach; crops with high labor input, 350 to 500 man hours per acre, such as asparagus, carrots, and tomatoes; finally, crops with very high labor input, 500 hours or more of man labor per acre, such as celery, lettuce, and strawberries.

On the basis of this classification, asparagus, carrots, beets, cabbage, celery, and tomatoes, that is, crops with either high or very high labor inputs per acre, were selected for the labor saving methods and technique study conducted this past summer. Varying amounts of data were collected on all the above named crops, but this paper will be limited to a brief discussion of carrots only. Most of the methods of procedure used on this crop are applicable to the other crops also.

In outlining this study two rather definite objectives were set up; first, to develop principles and procedure for working out labor saving methods and technique on vegetable farms; second, to determine labor saving methods and technique for specific labor operations on vegetable crops. In other words, it was necessary to work out methods of procedure before making studies of specific labor operations.

Data were collected by using a stop watch to get the exact time that it took on any specific farm to do the various operations in harvesting and preparing carrots for the market. Moving pictures as well as still pictures were taken of the different operations. Farms of low labor efficiency, and also those of high labor efficiency were studied in order to show variations in practices. In a few cases the most efficient farmers were found to be very inefficient in some respects; while some of the less efficient men in general, had developed some very desirable methods for certain operations. In many cases suggested improvements and changes in equipment or technique were tested under actual farm conditions with the assistance of vegetable growers who were interested in cooperating. Comparative records and observations of both the old and improved methods were taken.

In presenting this material it is fully realized that conditions vary from farm to farm, so that it would be impossible to recommend that every grower adopt the same labor saving technique. Other vegetable gardeners, however, may be able to follow the same principles in working out efficient methods and plans for their own special conditions. The main point to keep in mind is that of getting farmers to think about the efficiency of their own practices.

NOTES

A METHOD OF PRORATING COSTS BETWEEN MAIN PRODUCTS AND BY-PRODUCTS

The managers of many butter creameries in the state of California have for some years past felt the need for a more uniform and reliable accounting system which would make possible a comparison of operating efficiency between different plants. The problem of making creamery efficiency studies in California is complicated because of the great variation in the volume of butter produced by the different creameries and because of the fact that most of the larger creameries manufacture other dairy products besides butter. In 1930 nearly 74 million pounds of butter were produced by about fifty creameries. Output per creamery varied from under 200,000 pounds a year to over 6,000,000 a year. Many of the smaller plants received cream from patrons and manufactured butter only, returning the buttermilk to patrons. Nearly all the larger plants, however, received whole milk as well as cream from patrons and manufactured butter, evaporated or condensed milk, cottage cheese, casein or skim milk powder and butter milk powder, and sold some market cream and market milk.

About a year ago the College of Agriculture of the University of California began a study of creamery operating efficiency at the request of a number of plant operators. After a preliminary analysis of the operations of a number of creameries in different parts of the state, it became apparent that little progress in such a study could be made until all creameries cooperating adopted a more uniform system of accounting, especially as regards the proration of costs between the various products manufactured. The basis on which costs were allocated between departments and products varied from plant to plant and even in the same plant from time to time. It was the practice as a general rule to allocate expenses on some arbitrary basis which superficially seemed to be justified. The methods most commonly used were to prorate expenses on a labor-time, space used, value or volume basis or a combination of two or more of these. As a result, the managers of several of the creameries were faced with the anomalous position that while their cost records showed that one or another of the by-products were handled at a loss, the profits of the creamery as a whole were augmented by handling the by-product in a particular way. In the case of one creamery the basis of allocation of office and general expense was changed three times within the year in order to show a profit on the handling of milk powder.

All plant operators consider that each department must stand on its own merits and bear a proportionate share of the direct and indirect expenses. It is common to regard each creamery as a collection of watertight and independent departments, whereas it is really one business unit, the various operations dovetailing into and supplementing each other as regards the use of management, labor, and plant.

In nearly all instances the value of butter constituted over 75 per cent of the total sales value of all the products. In view of this fact it would seem that a more logical basis on which to allocate costs would be to charge to butter all expenses which would be incurred if butter only were manufactured and to the by-products only the additional expenses which are directly attributable to their handling. For instance, if the manufacture of casein entailed the employment of two laborers in addition to what would be necessary if butter only were produced, casein would be charged only with the wages of two laborers regardless of whether some of the other employees also devoted part of their time to the manufacture of casein. The

same principle would apply in the case of buildings and equipment. Such a method of allocating costs is justified because the manufacture of casein, while it may entail some additional expense for labor, plant, and machinery, actually makes possible a fuller utilization of the plant, equipment, and personnel which would be necessary for butter making.

Under such a system of cost allocation it would be possible for a creamery operator to ascertain exactly what additional expense per unit is necessary to manufacture casein. If the additional expense is less than the proceeds from casein sales, the creamery's net profit will be augmented. Comparisons of the unit additional expense between creameries and from year to year will give a fairly reliable indication of whether casein is produced efficiently or not. It should be plain that the additional unit expense involved in producing casein in conjunction with butter should not be regarded as a cost of producing casein.

The theoretical significance of the method of allocating costs above outlined is appreciated readily by economists. It is economically sound and places stress on the unity of each creamery as a business unit, while at the same time preserving comparisons of efficiency for each individual commodity. Some difficulty has been experienced in getting creamery operators to adopt the system. Most of them are inclined to look upon such a procedure as "subsidizing" one commodity at the expense of another.

The principle and advantages of this method of allocating costs were presented in some detail to a gathering of creamery operators last November. It is interesting to note that one creamery has already adopted this method of cost allocation and that arrangements are being made by two other creameries to do this at the end of their fiscal years. It is probable that if these three creameries find that this procedure for prorating expenses is satisfactory, others will adopt it shortly. This would greatly facilitate comparisons of operating efficiency among such associations.

J. M. Tinley

University of California

AGRICULTURAL COOPERATION AMONG THE GERMANS OF CZECHOSLOVAKIA

The German minority in Czechoslovakia is composed of about 3,400,000, about 23 per cent of the total population of the republic. Agriculture is the profession of the great majority of the German population of Czechoslovakia. For some considerable time agricultural cooperation has been very well organized among the Germans from the historical countries forming the present-day Czechoslovakia. At the present time, according to data published in the last issues of the periodical edited by the Central Union of the Agricultural Cooperatives at Prague, all of the agricultural cooperation among the Germans of Czechoslovakia is concentrated in three cooperative centers: Prague, Brno, and Opava. On the first of January, 1931 there were 2041 cooperatives registered as members of these three unions. Among these cooperatives there were: 1182 Raiffeisen cashes, 5 cashes for loans of the Schultze-Delitzsch type, 78 cooperative depots, 164 dairy cooperatives, 409 electrification cooperatives, 203 miscellaneous cooperatives.

We find on the balance sheets of these cooperatives about 33 million of their own capital, about 1.6 billions of deposits, and about 1.3 billions of loans, all in crowns. The annual turnover has exceeded 3 billion crowns. On the first of January, 1931 the budget of the three above mentioned unions comprised 10.6 million crowns of own capital, 439 million crowns of loans and about 400 million crowns of deposits.

Commercial organizations established in connection with the above mentioned unions have sold in 1930 about 23,400 wagons (100 quintals per wagon), out of which about 7000 contained manures, about 6400 contained coal and wood, and about 4200 contained corn. In consequence, in spite of the crisis which now reigns everywhere, German agricultural cooperation in Czechoslovakia occupies a very solid position and may be considered as a considerable factor of support for agriculture which at present finds itself in rather unfavorable conditions.

S. Borodaewsky

Czechoslovakia

THE INDEBTEDNESS OF AGRICULTURE IN CZECHOSLOVAKIA

The present-day crisis has had its influence in increasing the indebtedness of agriculture in Czechoslovakia. This is a natural result of the fall in prices for agricultural products.

Loans granted by the rural credit corporations (''kampelitchkys'') and by the regional banks of credit may be employed as a basis for arriving at the change in indebtedness, it being taken for granted that agriculturists constitute almost the entire clientele of these institutions.

The indebtedness of agriculture to the kampelitchkys reached 3.7 milliard Czech crowns in 1930 compared with 2.4 milliard in 1927. In the case of the regional banks of credit, the total was 3.1 milliard Czech crowns in 1930 and 2.1 milliards in 1927. The total loans of agriculture from these institutions thus were 6.8 milliard Czech crowns in 1930 as against 4.5 milliard in 1927. According to the *Journal of Agricultural Cooperatives* No. 45, 1931 (publication of the Central Union of Cooperatives in Prague), the total indebtedness is greater because agriculture not only takes advantage of loans granted by credit cooperatives but also borrows from private individuals and establishments. However, it must be taken into consideration that while these cooperatives had loans of 6.8 milliard crowns in 1930, they had at their disposal a deposit of about 9.5 milliard crowns. Furthermore, some of the borrowers maintain a deposit. On the assumption that these offset the loans of agriculture from private sources, the figure of 6.8 milliard crowns may be taken to represent the indebtedness of agriculture.

In spite of this, the indebtedness of agriculture in this country is heavy. Czechoslovakia is in a more favorable economic condition than its neighbors and probably will not resort to measures leading to the acceptance of all the debts of agriculture by the state itself. The problem of rational organization of agricultural credit nevertheless is a serious question for the Czechoslovak government, the solution of which can not be long postponed.

S. Borodaewsky

Czechoslovakia

DIFFICULTIES IN BULGARIAN FARMING

The world economic crisis manifests itself in Bulgaria in such an acute form that it really threatens to disorganize the entire national economy and to cause some dangerous disorders in our social and national life. The causes of the disastrous effect of the crisis upon this country should be looked for in the fact that even before the appearance of the difficulties in world farming, there began to arise in Bulgarian agriculture some signs of a failure which may be characterized as a structural crisis in this farming. The farm holdings all over the agricultural area are very small. The landowner himself tills the soil, and in the majority of cases avoids hiring labor, using

that of his own family for all purposes. Bulgarian farming is always supplying a surplus of workers who are unable to find occupation in a budding industry or to emigrate abroad. It lacks funds and is consequently poorly supplied with agricultural implements; it is deprived of the necessary money for the peasant's economy and living, and is therefore charged with debts contracted primarily for consuming purposes; in technical respect, because of the lack of sufficient professional agricultural instruction, it clings to a naïve empiricism, to tradition of past generations instead of using an enlightened rationalism. For all these reasons, Bulgarian agriculture having been directed mainly towards the production and exportation of grain—wheat and maize—was unavoidably doomed to catastrophic failure, since it could not be expected to keep up against the competition of the foreign markets of those countries whose agrarian structure and economic organization are more suitable for grain production. Under the stress of the growing population and its needs, a slow and inherent change took place on the farms towards the produce of intensive labor. This new orientation, however, meets with unsurmountable hardship in the destitution of both people and government.

The above stated characteristics of Bulgarian agriculture are corroborated by the following figures:

The average amount of arable land for each farm in decares[1]	49.79
Percentage of the peasant's own land	94.3
The average number of parcels for each farm	13.18
The average amount of a parcel of arable land in decares	3.78
The number of permanently occupied persons in farming per hectare	6.77
The number of hired laborers permanently occupied in one farm	0.04
The number of working cattle per ox-power unit in one farm	1.95
The amount of arable land in decares to a unit of working cattle	31.9
The value of agricultural implements and machinery per 1 decare land in dollars	0.4
The area occupied by grain culture compared with the entire area of arable land	61.63
The area occupied by grain culture compared with the entire field area	70.0
The value of the exported grain compared with the total value of Bulgarian exports during the years 1928-30	14.6

The crash in the prices of agricultural produce in the world market dealt a very hard blow upon Bulgarian agriculture which in its present situation is unable to adapt itself to such an unfavorable and changed level of prices, the Bulgarian peasant determining the prices of his produce not so much upon the cost of production, as upon the possibility of supplying his scanty needs and satisfying his creditors.

The situation becomes still more complicated from the fact that the difference in prices between agricultural and non-agricultural products is very keenly felt in a country poorly supplied with an independent industry, and consequently compelled to rely on the importation of foreign products whose prices are not reduced at the same rapid rate as those of the local agrarian products. This may be seen from the following table illustrating the movement of the index of wholesale prices, in gold, of various groups of goods:

[1] A decare equals one-tenth of a hectare, i.e., 0.247 of an acre.

TABLE 1.—INDEX OF WHOLESALE PRICES IN GOLD

	Food		Materials	
	Vegetable	Animal	Textile	Fuel
1928	160	126	153	109
1929	155	134	155	108
July 1–Dec. 31, 1929	141	137	149	105
Jan. 1–June 30, 1930	113	106	133	100
July 1–Dec. 31, 1930	82	99	108	96
Jan. 1–June 30, 1931	76	79	93	94

If we add to the above that the Bulgarian national debt to the foreign countries is very large, that the payments of interest and sinking of the national debt together with the reparations constitute more than 26 per cent of the expenditures of the national budget, and that the government, trying to cope with the situation, cannot help applying a severe policy of taxation whose burden is mainly to be felt by the agrarian population already impoverished and ruined by the devastating crisis, we could then have a clear idea of the hopeless situation which Bulgarian people, country, and economic life have come to at the present time.

All this, however, does not yet reflect the real extent of the calamity in an adequate way. The European nations, under the stress of economic difficulties, have adopted a policy of increasing their custom-tariffs for the protection of their national economy, thus preventing the eventual sale of Bulgarian agricultural products to a still greater extent. The prospects of Bulgarian exports will become still darker when the new system of tariff protection under the form of treaty contingents and preferential tariffs is applied, many considerations of high politics being very often hidden behind them. But even if such considerations did not exist, the situation of Bulgaria in the international market grows worse, since a poor and small nation is never sufficiently attractive as a contractor in an agreement of such a special nature.

The Bulgarian government is trying to alleviate the misfortunes suffered by the agrarian population. It monopolized the purchase of the main cereals, paying to the farmers prices higher than those of the world market. A part of these payments is made not with money but with special bonds which are accepted by the government treasury for the payment of strictly fixed governmental taxes. This policy secures to the farmer an artificial rise in the prices of the main cereals, but it is connected with a series of unfavorable consequences. First, it charges the already exhausted government with an enormous financial burden, since it really amounts to a remission of a part of the agrarian taxes. Moreover, the government suffers certain losses, a large part of the highly paid grain being sold abroad at a lower price. Secondly, the town and part of the rural population is compelled to pay a high price for bread, since the government, endeavoring to reduce its losses, sells the grain to the mills of this country at a higher price, thus rendering the situation of the town population which suffers from unemployment and want of money still more difficult. Thirdly, this policy renders essential services only to that class of farmers which possesses relatively larger quantities for sale, i.e., to the wealthier class; the small holders, however, as well as all the producers of agrarian products other than grain, the prices of which have also fallen at the same rate, do not derive any advantage from this policy and consequently accuse the government of unequally treating all the rural producers.

Much more unsatisfactory results are obtained from the efforts of the government

to reach an equalization in the level of the prices of agrarian and non-agrarian products by means of administrative measures. The number of goods subject to price standardization is very small, while the reduction of prices enforced by the government is also insignificant. Such a measure could not, on the whole, yield substantial results in a country with a frail industry, dependent upon the importation of foreign goods.

The central government tends toward an obligatory reduction of the farmers' debts, justifying it with the corresponding reduction of farm rentability and the fall of the consuming power of the rural population, as well as the corresponding rise of the purchasing power of the monetary unit. It is impossible to foretell whether this measure will succeed, since its application is already causing some unfavorable consequences—the credit has been reduced, and the peasants now meet with new and greater difficulties when trying to obtain credit.

Under the catastrophically hard conditions created by these circumstances, actual assistance could be given to Bulgarian agriculture only through a symphathizing intervention from abroad. Such assistance could manifest itself in the following steps. For the immediate relief of the suffering rural population, a reduction of its taxes is absolutely necessary. This can be realized only when an end is put to the reparations, and the payments of the national loans abroad are renewed (and perhaps reduced in the future). Economically this can be justified with the deep and lasting changes which occurred in the depreciation of the money value and that of the great mass of agrarian products. Such a relief of the tax burden would enable the government to discontinue the keeping up of high prices of grain through monopolized purchases which cause an enormous loss to the national treasury.

In order to restore the vitality of Bulgarian farming a long term loan is absolutely necessary for its complete reorganisation. Only by means of such a loan—since the resources of the government and the peasants are far too insufficient to do it—a new orientation of the peasants' farming could be created that would consist in its adaptation to the products of intensive labor which better correspond to the nature of its structure. On the other hand, a part of this loan would enable the farmers to convert their short term debts into long term debts to the agrarian credit institution of the state, the Bulgarian Agricultural Bank, and in this way the problem of the indebtedness of the rural population would be solved, a problem that just now bears such a dark and alarmingly insolvable character.

Without these steps based upon a sympathising credit intervention from abroad, Bulgarian farming cannot hope to come out of the existing situation and may drag the government and the nation into irreparable catastrophe.

N. V. Dolinsky

Bulgaria

AN APPLICATION OF "MOVEMENT THEORY" IN THE BEHAVIOR OF PRICES TO CORN PRICES[1]

In price analysis work there is coming to be increasing recognition of the validity of the contention that price trends are fitted to predetermined price movements but that price movements do not necessarily fit themselves to predetermined price trends.[2] The so-called "movement theory" of the behavior of prices holds to the view, often

[1] Contribution No. 77. Department of Agricultural Economics.
[2] Working, Holbrook; *Cycles in Wheat Prices*, Wheat Studies Food Research Institute, Stanford University, California, Vol. VIII, No. 1 Nov. 1931, pp. 2-3.

expressed by some business forecasters, that prices, to a certain degree, forecast themselves. The importance of price movement, as such, has attracted the attention of a good many observers. The statistical application of measures of central tendency to heterogeneous time-series of prices that really consist of several "statistical universes" rather than one, have given such fantastical results as to discredit the study of price movements as such independent of so-called fundamental factors. Furthermore, primary interest in the business cycle, has caused most statistical investigators to eliminate long time or major cyclical trends from their data, than by rather questionable methods attempt to eliminate seasonal or month to month trends within the year, leaving what is supposed to be pure short time cyclical trends which constitute the business cycle. Less attention has been given to an approach that attempts to leave major and minor cyclical trends just as they are, delimited by actual extreme high and low prices, and then within similar phases of cycles, to search for seasonal[3] regularities and relationships characteristic of different phases of major and minor cycles. In the latter approach, to the extent that distinctive seasonal regularities characterize different phases of major and minor price cycles, to that extent there is a month to month or seasonal criterion as to the longer time price trend that is in process of development.

TABLE 1.—THE DIFFERENCE BETWEEN THE TOP PRICE FOR THE FIRST TEN DAYS OF APRIL AND THE TOP FOR THE SECOND TEN DAYS OF APRIL, NO. 2 MIXED CORN, KANSAS CITY.

Crop Year	Cents	
	Up	Down
1909-10	—	3½
1910-11	1¾	—
1911-12	1	—
1912-13	2	—
1913-14	—	½
1914-15	3	—
1915-16	0	0
1916-17	13	—
1917-18	0	0
1918-19	6	—
1919-20	1	—
1920-21	1½	—
1921-22	5	—
1922-23	4½	—
1923-24	½	—
1924-25	6	—
1925-26	3	—
1926-27	1½	—
1927-28	5½	—
1928-29	1	—
1929-30	—	1
1930-31	—	½

It is the purpose of this paper to present only one example of a price movement or change in price relationships which is of some value in judging price trends in process of development. It can be demonstrated in the case of corn prices, as in the case of many other agricultural prices, that there are what, from the forecasters standpoint, might be called strategical points sometime in the year when impending large price changes are indicated to some degree by smaller ones.

The prices used in this study are, in the main, top No. 2 mixed corn prices at Kansas City. The top prices for each ten days of the month are used. From the first market day to the tenth of the month inclusive is counted as the first ten days of the month. From the eleventh to the twentieth inclusive constitutes the second ten

[3] The term seasonal, here, is used to refer to month to month price changes within the crop year as well as to change in price from one end of the crop year to the other.

days of the month and the rest of the month constitutes the third ten days of the month. Tops by ten-day periods are used to get away from the smoothing and leveling effect of arithmetic averages.

These corn prices exhibit a strong tendency to advance during the second ten days of April in particular. In sixteen of the last twenty-two years price has shown at least a little advance during the second ten days of April. In four years there was a decline in price during the second ten days of April and in two years price remained steady. (Table 1)

If in addition to the price change during the second ten days of April, the net change in price for the month is taken into consideration, it will be found that, ex-

TABLE 2.—NET CHANGES IN CORN PRICES FOR THE MONTH OF APRIL AS RELATED TO UP AND DOWN TREND PHASES OF THE CORN PRICE CYCLE

Year	Net Increase in Price		Phase of Cycle	Year	Net Decrease in Price		Phase of Cycle
	K.C. Top	Chi. Av. No. 3			K.C. Top	Chi. Av. No. 3	
1910–11	+ 4½	+ 5	up	1909–10	0	− 4	down
1911–12	+ 6½	+10	up	1913–14	−1	+ 3	up*
1912–13	+ 6	+ 6	up	1917–18	−7	− 5	down
1914–15	+ 4	+ 3	down*	1920–21	−3	− 5	down
1915–16	+ 3	+ 3	up	1924–25	−4½	−12	down
1916–17	+47	+31	up	1928–29	−0	− 4	down
1918–19	+12	+ 9	up	1930–31	−1¼		down
1919–20	+11	+11	up				
1921–22	+ 4	+ 1	up				
1922–23	+10	+ 6	up				
1923–24	+ 1	0	up				
1925–26	+ 2	− 1	down*				
1926–27	+ 4	+ 3	up				
1927–28	+10¼	+ 7	up				
1929–30	+ ¼	+ 2	down*				
15 years	* Failed to coincide.			7 years			

cept for about four cases out of twenty-two, whether corn prices go up or down in April indicates whether corn prices are in the uptrend or downtrend phase of the corn price cycle. A net increase in price in April indicates that corn prices are still in the uptrend phase of the corn price cycle or are entering that phase. A net decrease in price or failure to advance in April indicates that corn prices are still in the towntrend phase of the corn price cycle or are entering that phase. (Table 2). If change in price from March to April in the case of Chicago average price is used in addition to Kansas City top prices, an even stronger case is made.

In this case, as in many others, it is best to check with several price series, as local conditions sometimes get one market enough out of line with others as to be misleading if used alone.

Why April is such a strategic point in the seasonal price structure, there may be considerable difference of opinion. There are several factors that cause April to be an important turning point for corn prices. Murray[4] has indicated by correlation studies that a given United States corn crop has its maximum effect on corn prices in the April following harvest. De Villiers,[5] in an unpublished thesis, shows that the period of low Argentine exports extends from about December to May and that this is one factor that aids the seasonal advance in Liverpool maize prices from January to April. It has also been shown that since 1891 the visible supplies of corn in March

[4] Murray, Nat C., *Forecasting Corn Prices*, a paper given before the Chicago Chapter of the American Statistical Association, Dec. 1928.

[5] De Villiers, De La Harpe, *Monthly Maize Export Movements and Liverpool Prices*, unpublished thesis, Kansas State College of Agriculture and Applied Science, 1931.

and April have shown a larger secular increase than for any other month of the year.[6] This has tended to put increasing pressure on the March and early April market. If there is any strength at all in the market it should manifest itself shortly after this period by some noticeable advances in prices over short periods of time. In other words, around April is a "strategic" point for a so-called price "reaction" to take place. If under these most favorable circumstances there are no signs of much strength in the market, then there is little to hope for except random happenings now and then which do make for higher prices later in spite of the fact that there were no earlier signs of the advance.

There are undoubtedly other factors than those named which have a bearing on the strategic position of April prices in the corn market. The examples given are those that have been given some study, and are sufficient to indicate that there is a measure of reason for the importance assumed for April in analyzing corn price movements.

Numerous observations have been made of the fact that wholesale commodity price index numbers show turns upward most frequently in the period extending from January to June inclusive. The most reasonable assumption as to why this is true, is that a number of important individual commodities have important price turning points in the spring of the year. Corn is one of these commodities; hogs are another. It is likely that further investigation will reveal a number of agricultural commodities whose turning points in prices have a bearing on the time when composite index numbers more sluggishly show important turning points.

It is not the contention of this article that this method of price analysis alone should be used. It may be used to supplement other methods; it is an additional check on conclusions otherwise arrived at in a field where always some risk remains after the most calculating judgment. The author believes that for utility purposes the method is more readily put to work than is the orthodox theory of "levels" and "norms." Further than this, its observed workings may be the basis of modifying price theory that has sought largely for a "oneness" of cause that will explain prices. The method also perhaps most closely duplicates, in conscious study, what of value a limited number of successful individuals gain almost unconsciously from long years of experience in the market, and it is, up to the present at least, quite well agreed that such experience has been as productive or more productive of results than more elaborate probability studies.

R. M. Green

Kansas Agricultural Experiment Station

[6] Hollister, Harold Irving, *Some Factors Which Influence the July Price of No. 2 Mixed Corn at Kansas City*, unpublished thesis, Kansas State College of Agriculture and Applied Science, 1928.

BOOKS RECEIVED

Astor, Viscount and Keith A. H. Murray, *Land and Life.* London: Victor Gollancz, Ltd. 1932. 187 pp. 5 shillings net.

Clark, Fred E. and L. H. D. Weld, *Marketing Agricultural Products in the U.S.* New York: Macmillan Co. 1932. 672 pp. $4.25.

Collins, Charles Wallace, *Rural Banking Reform.* New York: Macmillan Co. 1931. 187 pp. $2.00.

Hoffman, G. Wright, *Future Trading upon Organized Commodity Markets in the United States.* University of Pennsylvania Press. 1932. 482 pp. $5.00.

Hurd, W. Burton and T. W. Grindley (under direction of) *Agriculture, Climate and Population of the Prairie Provinces of Canada.* Ottawa: F. A. Acland. 1931. 102 pp. $.50.

Ritter, Dr. Kurt, *Die Schweinehaltung der Welt und der Handel mit ihren Erzeugnissen.* Berichte über Landwirtschaft. Berlin: Paul Parey. 1931. 366 pp. 27,50 RM.

Wantrup, Dr. Seigfried von Ciriacy, *Die zweckmafigen Betriebsgrofen in der Landwirtschaft der Vereinigten Staaten von America.* Berlin: Paul Parey. 1932. 149 pp. 10,60 RM.

BOOK REVIEWS

Economic Stabilization in an Unbalanced World, by Alvin Harvey Hansen. New York: Harcourt, Brace & Co. 1932. pp. ix, 384. $3.00.

Professor Hansen's volume will command the close attention of all serious students of the problems of post war international economic relations. The writer particularly commends the volume to those who wish a balanced digest and a sane evaluation of current economic thought in England, Germany, and the United States concerning many of the more urgent aspects of the problems of economic readjustment. Professor Hansen's analysis becomes peculiarly enlightening if examined on the one hand in relation to J. M. Keynes, "Economic Consequences of Peace," published in the disturbed days immediately following the Versailles Treaty, and on the other, by reference to the developments of the spring of 1932 in Europe since its evaluates in condensed form the peaks of economic development of these twelve and a half years. Current developments, as the issues raised by the moratorium, the proposed Central and Southeastern European trade union, the Wagemann credit plan, Mr. McKenna's suggestions as to a "managed" currency in Great Britain, the German elections of last Sunday (this is written on March 17), the decline in the German export balance, the recent strengthening of the British exchange rate and revival of talk as to the British return to the gold basis are here placed in economic and historical perspective.

It is impossible within the limits of a brief review to summarize the factual material, the digest of economic thought and the constructive opinion of the author. Hence, what follows should be read as an inadequate outline of some of the aspects of the book which particularly appealed to the reviewer.

Part I deals with the international causes of instability. The essence of the discussion is the assumption first of a pre-war balanced international economy based on "an international division of labor which had slowly and gradually been built up during the preceding half century," and second, the analysis of the chief disturbing influences interfering with the reversion to the pre-war condition of equilibrium. Considerable evidence is presented to indicate the general tendency to return to the fundamental long time trends of the pre-war situation. The chief factors preventing the full return to a balanced world economy are held to be:

1. The creation of numerous petty states and post-war tariff legislation.
2. Differential labor costs due to the unequal rate of progress of social legislation and trade union control between nations.
3. Technological changes and the rationalization movement.
4. Monetary disturbances.
5. The redistribution of world wealth.

Rather than review the discussion of all of these factors only a few of the more pertinent conclusions arising out of the discussion will be presented:

1. It is a "grave mistake to assume that there is no shortage of capital in Germany because one can find abundant evidence of overcapacity in her industries" (p. 149).
2. The German capital market is the weak link in the German economic structure (p. 52).
3. The payment of reparations contributes to "produce or intensify business depressions in Germany but *reasonable* reparation payments can doubtless be made in the long run" (p. 63).
4. American tariff policy has had the effect of "placing the trade and production of the outside world in the deadly grip of credit contraction" (p. 82), but does not

"in the 'long run' necessarily preclude the payment of reparations, war debts, and the interest accruing from American investments abroad" (p. 83). It is not the balance of trade but the *volume* of trade that is affected by tariff policy. Net capital movements determine the balance of trade (p. 86). American tariff policy intensifies maladjustments and interferes with the balanced distribution of the world's gold supply, but eventually a new equilibrium will be achieved in which the United States will have a net excess of imports of goods and services.

5. "Gold absorption and changes in the monetary structure operating persistently through several years" (p. 106) produced the violent fall of prices in 1929-1930. Since the annual output of goods bids fair to exceed the output of gold for the next ten years, the world price level will continue downward unless there are changes in banking practice (p. 107).

Part II carries the heading "World-Wide Unemployment." A brief presentation of unemployment statistics for the leading nations is followed by a discussion of the causes of unemployment. The causes of unemployment are enumerated as follows:

I. Seasonal movements.
II. Cyclical fluctuations.
III. Structural changes.
   1. Changes in the technique of production.
   2. Changes in the location of industries.
   3. Changes in demand.
   4. Appreciation of the monetary unit.
   5. Uneconomic wage level.
   6. Overpopulation.
   7. Scarcity of capital.

In the discussion of these factors Professor Hansen emphasizes that excess capacity is the result of *maladjustment* and does not depend upon the volume of savings, and that the economic value of high wages must be judged by the effect upon production, since this is the only way in which consuming power may be increased. Here, and elsewhere, the author maintains that a sound case for the thesis of over saving cannot be made. (See p. 155.) Basic in all of the reasoning is the assumption that the increase of the total of goods produced, and of employment and per capita product, is bounded by money and credit limitations; hence, an abnormally high wage level would make merely for unemployment since all labor could not be used at that level and displaced labor could find no employment because of the strain placed upon credit facilities. It follows that if the money and credit limitations are somewhat inflexible then wages and prices both must decline and any interference with this tendency makes merely for serious maladjustment.

The critical examination of proposed remedies for unemployment for the most part ends in a pessimistic vein; shorter hours, the elimination of juvenile labor and the pensioning of older workers, advertising, installment selling, the development of new industries and the like for the most part offer nothing; whereas the stabilization of the business cycle and the regularization of industry could be achieved only at the expense of economic progress or by the introduction of the rigidity of a controlled economy. The economic effects of unemployment insurance are "mixed," neither "wholly good nor wholly bad," yet capitalism must work out some procedure "more efficient and sensible than charity and poor relief" (p. 209).

For lack of space the consideration of Part III, Population Stabilization, must be brief.

Overpopulation is a matter of the relationship of numbers to the standard of liv-

ing. Unemployment is not necessarily a derivation of "overpopulation" for sparsely populated countries like the United States have had more unemployment than densely populated countries like England or Belgium. It is exceedingly difficult to determine whether a country is over or under-populated. "Private capitalism is unable to furnish adequate economic motivation for the maintenance of population at the most desirable level" (p. 224). There is a declining birth rate in modern times due to increasing industrialization and urbanization. Of unusual significance are the recent revolutionary changes in age distribution (p. 229). Professor Hansen predicts that in thirty or fifty years, population growth in Europe and America will likely approach stablization and then the Asiatics will probably take the lead (p. 237).

A presentation of the facts and results of European migration is followed by a discussion of comparative wages and the standard of living, and the conclusion is reached that "while, on the average, the purchasing power of wages is higher in America one cannot say that the standard of living is higher" (p. 262); rather "something approaching an international standard of living for northwestern Europe and the United States" had been established by 1930 (p. 267).

Many of the observations of Part IV, "Toward a Stabilized Capitalism," have been prognosticated in the review of the first three divisions.

Economic equilibrium cannot be reestablished except on an international basis; and the Bank for International Settlements must assist here in securing a more balanced distribution of the world's gold.

In a trenchant analysis of the problem of economic progress in relation to falling prices the author concludes that it is impossible to achieve business stability in a dynamic society because it is impossible to have both an equilibrium of the rate of investment and savings and a stable price level. "A fall in the price level due to cost-reducing improvements is not consistent with the maintenance of business prosperity" (p. 286) because of the maladjustments that it provokes. The conclusion reached is that on the whole "rising money incomes and a stable or gently rising price level are more favorable . . . to the full and steady employment of the factors of production" (p. 291). The various forms of price stabilization are evaluated, the best index to stabilize it is decided is the wholesale-commodity price index, from the standpoint of business stability in the long run. Within the wholesale-commodity price index those commodities that are least "cycle sensitive" should be selected for stablization. (See p. 312.)

The dilemma of social control is clearly set forth in Chapter 21 dealing with *laissez-faire* and social control. An economic system with a *laissez-faire* gold standard and a general condition of sheltered and unsheltered industries with and without price controls—must inevitably have serious maladjustments. Organized restriction of output purchases stability at the cost of a lower standard of living (p. 318). Apparently, Professor Hansen concludes that social control can best be approached "from the monetary side" (p. 320). In any case, "we have to choose between security and progress" (p. 321).

The summary of the author's final position can best be made in terms of his general attitude and his constructive suggestions. The general feeling throughout is not one of optimism. There is no guarantee that private capitalism will survive; rather the spirit of capitalism, squeezed as it is, may be quenched. Yet, to survive, private capitalism must achieve a larger measure of stability. Since it is possible only to mitigate and not control the severity of the fluctuations of production the "outlook is pessimistic" (p. 364). Constructively, therefore, the prime opportunity consists in steadying consumption by the means of unemployment reserves "accumulated

in periods of prosperity and paid out in periods of depression'' (p. 371). But this policy would not regularize output as a whole; it would level off only consumer purchasing power, not total purchasing power. Hence, since the business cycle must be assumed as inevitable, efforts should be made to convert its slack periods into periods of social utility by providing cultural and vocational adult education. One other constructive proposal is offered; viz., that inflation is not a sound remedy for the depression, only ''hard work'' and ''painful readjustment'' will bring us out, with the prospect of ''having to repeat the process in the future'' (p. 378).

E. T. Grether

University of California

Making Farms Pay, by Cornelius J. Claassen. New York: Macmillan and Company. 1931. pp. xvi, 126. $2.00.

This little book, according to the sub-titles, is ''a way out for owner and tenant, a narrative of personal experiences in managing 1000 farms.'' The author is in charge of the Farmers' National Company, an organization furnishing group farm management service. The accomplishments of this company and the advantages of such services to farm owners and tenants are described. The materials presented are of most interest and value from the standpoint of the possibilities of such services. The discussion of methods is incidental and the one who wants to know how it is done will find this question only partially answered. ''This book . . . is solely intended to show how the knowledge obtainable from books, from agricultural colleges, from government institutions, can be put to work in the cause of the landlord who doesn't operate his own farm.''

W. E. Grimes

Kansas State College

Wheat, by W. W. Swanson and P. C. Armstrong. Toronto: The Macmillan Company of Canada Ltd. 1930. 320 pp. $3.00.

''Wheat, according to the dictionary, is an important food grain. It may be that in Britain, or in the Canadian diet, but in western Canada it is the lifeblood of commerce and industry, the very plasm of society. . . . For clarity, and since we hope that the book will go to many readers who are somewhat vague about summer-fallowing, or hedging, or the combine, we have touched on every stage in the production and marketing of the crop, but only that through it all we may try to weave what seems to us the vital thread of wheat as the means by which we are making a country out of what was but a few years ago the Great Lone Land.'' This statement, with which the authors preface their work, serves to indicate their intention that the subject of *Wheat* should be, not primarily the grain, but the economic, and to a considerable degree, the social and the political life of western Canada.

Nevertheless, about half of the book is devoted to the methods of marketing Canadian wheat, and related topics. From the standpoint of most readers outside the prairie provinces of Canada, the book is perhaps best described as divided about equally between a broad and stimulating discussion of the economic and social life and problems of western Canada and a fairly detailed treatment of the marketing of Canadian wheat, with, naturally, a good deal of overlapping between the two subjects. These two rather distinct aspects of the work may well be described separately.

Chapters I-IV present a vivid picture of the wheat country and its people and an account of the methods and problems of wheat growing and harvesting as there car-

ried on. Chapter V on "Statistics" starts with comments on crop reports and statistics, passes into a discussion of statistics of production costs, and comes to the conclusion that "The measures of agricultural prosperity are not to be found in figures. . . . Agriculture . . . is a biological activity—the attempt of the human race to better its adaptation to the planet. Its success is only possible if its practice tends to the physical, the intellectual and the moral betterment of the race. When the cost of raising wheat is at this point, it is right."

After nine succeeding chapters more specifically devoted to questions related to the marketing of wheat, the broader subject again assumes prominence in the three final chapters, dealing respectively with the transportation system of Canada, the government and the wheat grower, and an appraisal of the probable future of western Canada. The romance of the development, against great obstacles, of Canada's rail transportation system is effectively portrayed and the main features of its present state sharply outlined. There ensues a discussion of proposals for new developments and of changes in freight rates on wheat which is conspicuous for its broad consideration of the character of the wheat movement and the complexity of the factors affecting it. It is marred, unhappily, by the belief that the question of incidence of transportation costs is covered by the surprising "axiom" that "in a buyer's market the purchaser pays the freight, saves by its reduction, or suffers from its increase" (p. 253) and the companion doctrine that the price of Canadian wheat has generally been dominated by a buyer's market.

The government is commended for its many efforts in the interests of the wheat grower. It is suggested, however, that the settlement of the West by immigration has not been sufficiently supervised and that "the time has come when it is undesirable to have further governmental interference with the grading of wheat" (p. 278).

The appraisal of the future of western Canada, as it may be reflected in statistics, includes emphasis on the fact that there is no longer much good free land to be had in western Canada, and rests largely on a belief that the population of the region will continue to expand, but at a decreasing rate, the "result of certain natural laws and not of the efforts of men" (following a logistic curve?); that wheat acreage will follow population growth; and that with growth of population will come diversification of agriculture and some industrial development. It is held that whether wheat prices are high or low will make little difference as regards the expansion of acreage.

Several interesting suggestions are offered as to the character of the agriculture that may develop. The writers hold that the mechanization of agriculture will not lead to corporation farming or otherwise greatly alter the type of agriculture. They emphasize the distinction between the rural and the urban type of society, and take the position that the opening up of the free land of North America brought a decadence of rural society in the older agricultural communities and a largely urban type of society in the newer agricultural regions. They hope for a renaissance of the rural type of society in agriculture, safe now from the destructive competition of great new agricultural areas. In this society an enlightened cooperation between landlord and tenant should play, they hold, a large part.

The marketing of Canadian wheat is admirably treated in a series of chapters covering every stage from the country elevators to the foreign wheat market and the Canadian mills and their export flour market. Though a description of marketing machinery and methods predominates, it is richly supplemented with interpretative analysis and appraisal from the standpoint of the welfare of the Canadian wheat

grower and of the Dominion as a whole. The latter note is especially strong in the excellent chapters on "Building the Cooperative System" and "The Wheat Pools."[1]

A work including so much of interpretation and appraisal over such a broad field inevitably touches numerous controversial subjects. It is a conspicuous merit of the work that these many controversial points are suggestively developed and discussed with balance and moderation. To attempt appraisal of the numerous judgments passed would be out of place here.

We feel compelled, however, to note dissent from a price theory which is developed in the book and which plays an important part in interpretation of the opportunities and functions of the wheat pools and in appraisal of the effects of changes in transportation costs. The theory is that the "British quotations are essentially the foundation of the market" (p. 214); that "Liverpool is never bullish, but always bearish"; (p. 222) and that "in such a market . . . bargaining on behalf of the seller must . . . be as skillful and as purposeful as is the buying" (p. 223). The views expressed in the first two statements, though rather widely accepted, are demonstrably false. If they be abandoned, the apparent importance of strong and skillfully applied bargaining power largely disappears. Skillful merchandising has a place, but its use does not require bargaining power based on control of the sale of a large proportion of the crop.

Holbrook Working

Food Research Institute

[1] For those not familiar with recent developments, it may be noted that the heavy losses incurred from the carrying of huge stocks of wheat through the great price decline from the summer of 1929, forced a liquidation of the Central Selling Agency, beginning in the summer of 1931. "The Canadian Pool," as a unit, no longer exists, but the three separate Provincial Pools continue substantially unaffected except that each does its own selling instead of turning its wheat over for sale by a central organization controlled by the three together. From the point of view of those who attach great importance to concerted action in selling, cooperative wheat marketing in Canada has suffered a severe blow; from the point of view of those who see but slight advantage in a unified sales policy, the Canadian Cooperatives appear most fortunate to have weathered a severe storm with such a minor sacrifice.

NEWS ITEMS

The secretary announces that the next annual meeting of the American Farm Economic Association will be held at Cincinnati. The decision, it will be recalled, is made on the basis of the votes of the officers of the several associations which usually meet at the same time.

On February 29, 1932, a *Land Use Forum* was held at the College of Agriculture of the University of Wisconsin, Dean Chris L. Christensen presiding. The principal speakers were Governor Philip LaFollette, President Frank of the University, Professor George S. Wehrwein, Dr. Raphael Zon, and Provost A. R. Mass, Cornell University. The proper utilization of marginal lands of the Lake States was the principal topic for discussion.

The Association of Land-Grant Colleges has appointed a committee to investigate the effect of the economic situation on agriculture. Members selected by Dr. R. A. Pearson, Chairman of the Executive Committee, to act on this committee are: Dean Thomas Cooper, University of Kentucky, Dean H. W. Mumford, University of Illinois, Professor H. R. Tolley, University of California, Professor G. F. Warren, Cornell University and Professor M. L. Wilson, Montana State Agricultural College.

The Third Annual Short Course in Land Management was held at the University of Minnesota, on February 10 and 11. The discussions were designed mainly to apply to problems confronted by holders of groups of farms.

A drastic program of reorganization and consolidation of the higher educational institutions of Oregon was adopted by the State Board of Higher Education at a meeting on March 7. Administration of the University, State College, and the three normal schools is to be combined under a chancellor who will be located at the state capitol. Under the new plan there will be six major schools on the University campus at Eugene and six on the State College campus at Corvallis. At Eugene the six schools will be law; social science; fine arts; physical education; business administration and commerce; and literature, language and arts. At Corvallis will be agriculture; home economics; engineering; physical and biological sciences; forestry; and pharmacy. Included in the major changes involved are the transfer of science from the University to the State College, the transfer of business administration and commerce from the State College to the University, and the discontinuance of the School of Mines at the College and of the School of Journalism at the University. The University of Oregon medical school in Portland will be continued.

The research assistants on the project on agricultural land utilization in New England, which is being conducted under the auspices of the Harvard Committee on Economic Research, are Miss Martha Epps, formerly with the Forest Taxation Inquiry of New Haven, Miss Marian Brown, formerly with the Massachusetts State College, and Mr. Wendell James, formerly of Connecticut Agricultural College.

Miss Lois Bacon and Mr. Constantine Ladas have been assisting with the project on International Statistics of Agriculture being conducted at Harvard under a grant from the Harvard Bureau of International Research. The first number in the series of reports on this project, dealing with Switzerland, will be published shortly by the U. S. Bureau of Agricultural Economics.

The Department of Agricultural Economics of the University of Maryland is conducting a class in Food Products Inspection, to provide elementary training in how to buy intelligently, whether on a small scale for home use or on a large scale for restaurants, hotels, chain and other retail stores. Quality and the factors influencing quality are stressed throughout the course. Products studied include fruits, vegetables, canned goods, poultry products, grains and flours, dairy products, meats and sea foods. Illustrative material has been provided for each session of the class, and lectures and demonstrations are given by persons who have had years of experience in the purchase of food products.

Mr. Don S. Anderson, Instructor in Agricultural Economics, University of Minnesota, has resigned to accept a position as Assistant Professor of Agricultural Economics at the University of Wisconsin. Mr. Anderson will give special attention to price research in his new position.

Mr. C. R. Arnold returned to Ohio State University on January 1, after six months with the Bureau of Agricultural Economics, United States Department of Agriculture.

Dr. W. G. Binnewies is assisting in courses in sociology at Colorado State Agricultural College this semester and will give courses at the University of Nebraska summer session of 1932.

Mr. Andrew Cairns, who has been seconded by the Canadian Wheat Pool to the Empire Market Board, England, is at present in Russia where he is studying the prospects of collecting information on Russian wheat production. It is anticipated that Mr. Cairns will be in Russia for about four months.

John Cassels, formerly of the University of Alberta and for several years connected with state marketing control work in British Columbia, then Rhodes scholar at Oxford for three years, and last year a graduate student at Harvard University, has succeeded Professor Murray R. Benedict as associate to Dr. Black in handling the course work in agricultural economics at Harvard.

Mr. A. K. Chiu, in charge of agricultural economics research for the Chinese Institute of Social Science Research, is at Harvard this year working up the results of a field survey of several rural villages made last year.

Dr. Leo Drescher of Germany, who is in the United States under a Rockefeller Foundation Fellowship, is doing his research work this semester at Wisconsin. He is particularly interested in studying changes in farming methods as influenced by the development of marketing facilities.

Dr. Mordecai Ezekiel addressed the general seminar in economics at Harvard University on Monday evening, February 15. The subject of his talk was "Stability vs. Flexibility as Means to Economic Adjustment," and the thesis which he undertook to support was the need for greater flexibility in the various institutional and contractual arrangements which are being set up increasingly in modern society.

Mr. Earl R. French executive secretary of the New Food Marketing Research Council since 1924, resigned in February to take a position with the Great Atlantic and Pacific Tea Company.

Professor C. C. Gentry, assistant in sociology has been granted leave of absence from the Colorado State Agricultural College during the year 1931-32 to permit him to undertake graduate study at the University of Southern California.

Peter Hansen, who received the master's degree in agricultural economics at the University of Minnesota in 1930, is employed on emergency work for the Department of Agricultural Economics at South Dakota State College.

Mr. H. F. Hollands is joining the staff of the Division of Agricultural Economics at the University of Minnesota as instructor.

Professor J. H. Kolb of the Rural Sociology Department, University of Wisconsin, is in New York City this semester analyzing data on rural social trends. This project is undertaken in connection with the President's Commission appointed to make such studies in the United States.

Mr. H. R. Moore has been granted a year's leave of absence from the Rural Economics Department of the Ohio Agricultural Experiment Station, to pursue graduate work at Northwestern University.

Professors William Mortenson of the University of Wisconsin and J. A. Hodges of Kansas Agricultural College are spending the second half of the year at Harvard University.

Miss Paulena Nickell, who has been taking graduate work in agricultural economics at the University of Minnesota, has accepted a position in home economics at the University of Illinois.

Mr. John O'Donovan, formerly of the University of Dublin, last year at the University of Oxford, England, is dividing a year and one-half of study in the United States between Harvard, the graduate courses in agricultural economics of the Social Science Research Council in Washington, and the University of California.

Professor Henry C. Pepper, formerly at the University of Iowa, has been engaged in teaching sociology at Colorado State Agricultural College. He is making a study of county government and administration as a research project during the second semester.

W. F. Schnaidt, formerly extension specialist in marketing at South Dakota State College, who was on a leave of absence for one year while working with the Northwest Grain Association, has accepted a position with the grain section of the Division of Cooperative Marketing, Federal Farm Board.

Mr. P. S. Stricker who was temporarily connected with the economics staff of the University of Delaware, is assisting with a land utilization study at Pennsylvania State College.

T. S. Thorfinnson, extension specialist in farm management at South Dakota State College, is temporarily on leave from this institution doing extension work in economics for the Office of Cooperative Extension work, Washington, D.C. He is employed under a cooperative agreement whereby he will spend a part of his time during the year in South Dakota.

The American Farm Economic Association is now in position to supply all back numbers of the JOURNAL OF FARM ECONOMICS. The price is $1.25 per copy.

The Association will purchase from members back numbers of No. 1, Volume I to No. 2, Volume V inclusive at $1.00 per copy.

Address all communications to:

ASHER HOBSON, *Secretary-Treasurer*
College of Agriculture
Madison, Wisconsin